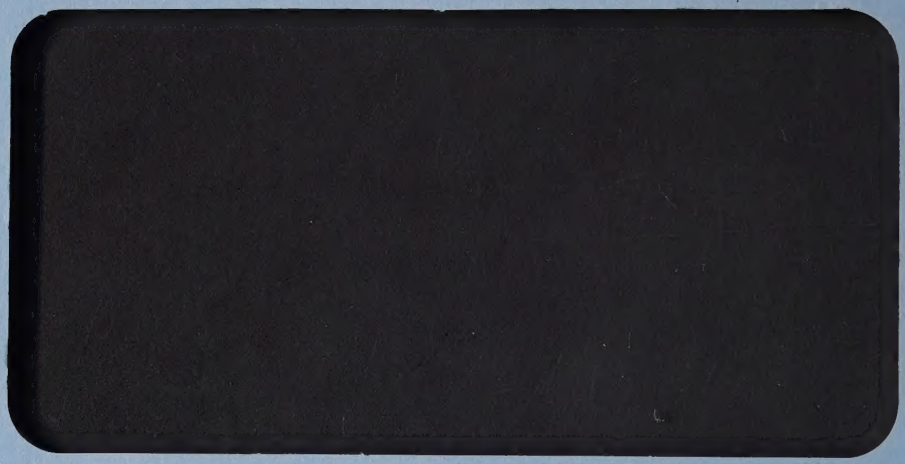
OPERATING AND MAINTENANCE MANUAL

KROHN-HITE CORPORATION
Avon Industrial Park/Bodwell St., Avon Massachusetts 02322 U.S.A.



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75 WATT

WIDEBAND AMPLIFIER

MODEL 7500 SERIAL NO.

OPERATING AND MAINTENANCE MANUAL

KROHN-HITE CORPORATION

Avon Industrial Park / Bodwell St., Avon, Mass. 02322

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CONTENTS

Section		Page
1	GENERAL DESCRIPTION	1
2	OPERATION	9
3	INCOMING ACCEPTANCE AND PERFORMANCE CHECK	13
4	CIRCUIT DESCRIPTION	17
5	MAINTENANCE	25
6	CALIBRATION	29

ILLUSTRATIONS

Figure		Page
1	Model 7500 Amplifier	ii
2	Typical Average Power Output vs Frequency Curve	4
3	Typical RMS Voltage Output vs Frequency Curve	5
4	Typical RMS Output Current vs Frequency Curve	5
5	Typical Distortion vs Frequency Curve	6
6	Typical Frequency Response Curve	6
7	Response to Square Wave Input	7
8	Operating Controls, Connectors and Indicators	8
9	AC Input Wiring Diagram	9
10	Output Current Limiting Curve	12
11	Test Setup for Measuring Power Output	14
12	Simplified Block Diagram	17
13	Input Stage	18
14	Second Stage	19
15	Driver Stage	19
16	Output Stage	21
17	Power Supply	22
18	Feedback and Loop Stabilization	24
APPENDIX		Inside Back Cover
	Schematic Diagram, Component Layouts, Parts List	

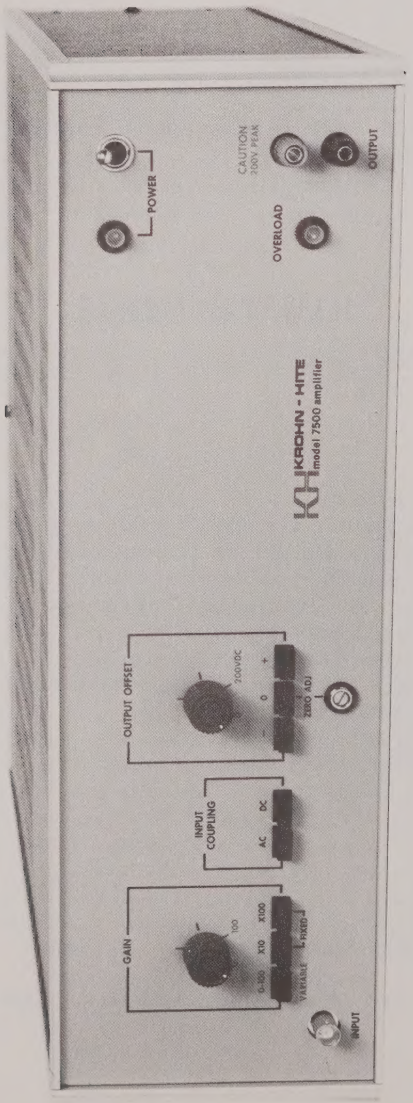


Figure 1. Model 7500 Amplifier

SECTION 1

GENERAL DESCRIPTION

1.1 INTRODUCTION

The Krohn-Hite Model 7500, shown in Figure 1, is an all solid state, direct coupled amplifier, that provides 75 watts of continuous power (150 watts at DC), at 125 volts RMS, from DC to 100 kHz. Frequency response of the 7500 is flat to within 0.1 db, and harmonic distortion at full power output is less than 0.1%, from DC to 10 kHz. A front panel control selects 20 db (10) or 40 db (100) of fixed gain, or zero to 40 db of continuously variable gain. The output of the 7500 can be offset ±200 volts, open-circuit, by means of a front panel DC offset control. The 7500 provides selectable input coupling, either direct (DC) or capacitive (AC).

The amplifier's output is protected from short-circuit or other abnormal load conditions by a unique output protection circuit, that uses a modified form of foldback current limiting. The output stage is convection cooled by a special heat sink configuration.

An optional rack-mounting kit (Part No. RK-519) is available for installing the unit in a standard 19" rack spacing.

The amplifier is carefully inspected, aged and adjusted before shipment, and should be ready for operation when it is unpacked. If it appears to have been damaged in shipment, make a claim with the carrier, and notify Krohn-Hite immediately.

1.2 SPECIFICATIONS (Specifications apply after a 30 minute warm-up.)

Frequency Range

DC to 1 MHz

Output Power, Voltage & Current (Specifications apply using a 200 ohm resistive load):

Power: 75 watts, DC to 100 kHz; 40 watts at 500 kHz; 10 watts at 1 MHz.

Voltage: 125 volts RMS, DC to 100 kHz; 90 volts RMS at 500 kHz; 45 volts RMS at 1 MHz.

Current: 625 milliamperes RMS, DC to 100 kHz; 450 milliamperes RMS at 500 kHz; 225 milliamperes RMS at 1 MHz.

Frequency Response

Flat to within ±0.1 db, DC to 1kHz; ±1.5db to 500kHz; -3db at approximately 1 MHz.

Harmonic Distortion

At 75 watts into 200 ohms, less than 0.1% to 10 kHz, approximately 1% at 100 kHz.

Voltage Gain

Fixed, 20 db ±0.2 db (X10) or 40 db ±0.2 db (X100), or continuously variable, zero to 40 db.

Gain Stability

Less than ±0.1 db change for a 10% change in line voltage.

Dynamic Range

Greater than 85 db.

Phase Shift

Zero ±1 degree from DC to 10 kHz. Phase shift increases linearly to 100 degrees (lagging) at 1 MHz.

Square Wave Response (At 100 V_{p-p} into 200 ohms)

Risetime, less than 500 nsec, overshoot less than 5%. Zero droop in DC coupled mode.

Maximum Input Voltage

±20 volts peak in the VARIABLE and ×100 GAIN positions; ±200 volts peak in the ×10 GAIN position.

Maximum DC Component

±200 volts (except VARIABLE GAIN position) in the AC position of the INPUT COUPLING switch.

Input Sensitivity

1.5 volts RMS at maximum gain setting.

Input Coupling

Either direct (DC), or capacitive coupling (AC) with low frequency cutoff at approximately 1 Hz.

Input Impedance

1 megohm in parallel with 85 pf in fixed gain modes; 5,000 ohms in variable gain mode.

Output Regulation

No load to 200 ohms, less than 0.5%, DC to 10 kHz.

Output Hum and Noise (1 MHz Bandwidth)

Less than 4 millivolts RMS with input shorted; less than 10 millivolts RMS with input open and shielded.

Output Coupling

Direct.

Output DC Level

Normally zero volts. Adjustable.

Output DC Offset (No Load)

Variable, zero to ±200 volts. Combined AC plus DC offset limited to ±200 volts.

Output DC Level Stability (After Warm-Up)

Vs. Line (short term): Less than 1 mv for 10% line voltage change.
Vs. Time: Less than 2 mv/8 hr.
Vs. Temperature: Less than 5 mv/^{o}C.

Internal Impedance

Less than 1 ohm, DC to 10 kHz; less than 10 ohms at 100 kHz; less than 75 ohms at 1 MHz.

Load Impedance

Capable of driving any load within the voltage and current limitations of the amplifier.

Load Power Factor

1.0 to zero, leading or lagging.

Ambient Temperature

0^{o}C to 45^{o}C.

Controls

Front Panel: POWER switch, 3 position push-button GAIN selector, variable GAIN control, 3 position push button DC OFFSET selector, variable OFFSET control, screwdriver control for DC output level.

Rear Panel: CHASSIS/FLOATING ground switch.

Front Panel Indicators

Power ON, output OVERLOAD.

Terminals

Front Panel: BNC for INPUT, binding posts for OUTPUT.

Rear Panel: BNC for INPUT, binding posts for OUTPUT, AC power receptacle, chassis grounding post.

Power Requirements

105-125 or 210-250 volts, single phase, 50-400 Hz, 85 watts quiescent, 400 watts maximum.

Fuse Protection

AC line, 5 ampere slow blow (115 V), 2.5 ampere slow blow (230 V); output stage unregulated supplies, 1 ampere fast blow (each supply).

Dimensions and Weights

Model 7500: 16-5/8" wide, 5-1/4" high, 17" deep, 35 lbs/16 kgs net, 40 lbs/18.2 kgs shipping.

Optional Rack-Mounting Kit

Part No. RK-519: Permits installation of the 7500 into a standard 19" rack spacing.

1.3 PERFORMANCE CHARACTERISTICS

The performance characteristics of the Model 7500 are illustrated in Figures 2–7. Figure 2 represents the amplifier's typical output power levels for different resistive loads. The maximum power output of 75 watts is obtained with a 200 ohm load. Figures 3 and 4 represent the amplifier's RMS voltage and current output, under similar load conditions. The amplifier's maximum output voltage is approximately 140 volts RMS, open-circuit. The maximum output current is obtained with a 100 ohm load. Figure 5 shows the typical distortion of the 7500 at full power (75 watts) output. Distortion in the 7500 is less than 0.1% over most of its range. Figure 6 represents the frequency response of the 7500 for both open-circuit and full power output conditions. The frequency response of the 7500 is typically within 0.5 db over most of the range. The response of the 7500 to a square wave input is shown in Figure 7 (b); the input of the 7500 is shown in Figure 7 (a). Note that the amplifier produces very little ringing or overshoot on the signal, and that there is little, if any, rounding of the square wave's corners.

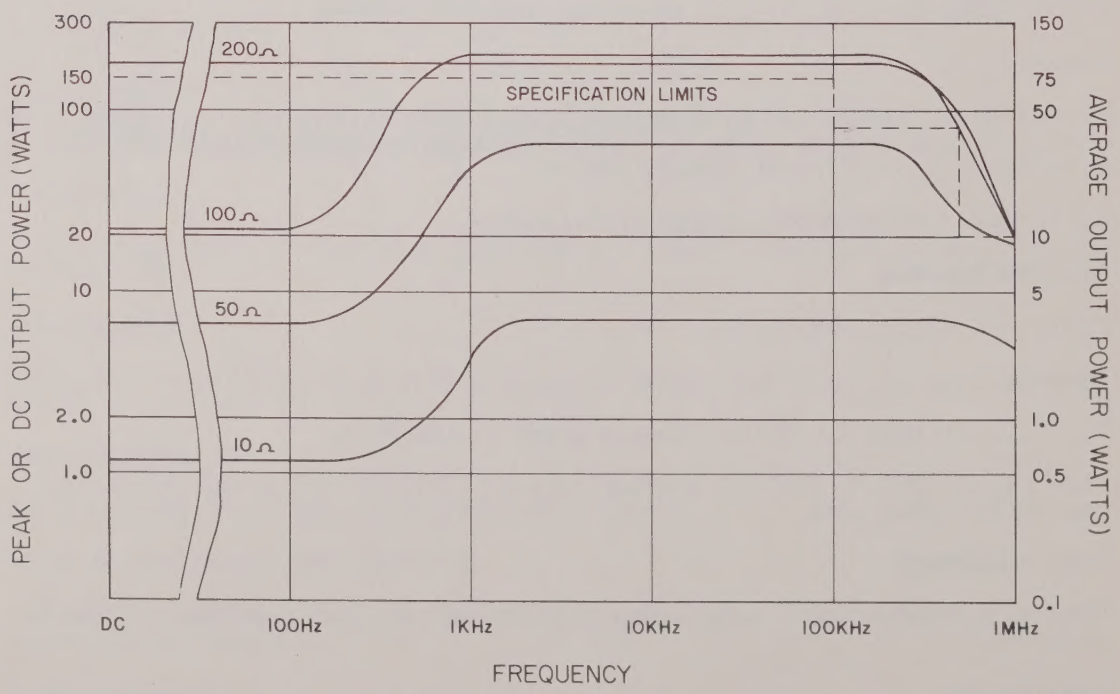


Figure 2. Typical Average Power Output vs. Frequency, for Different Resistive Loads.

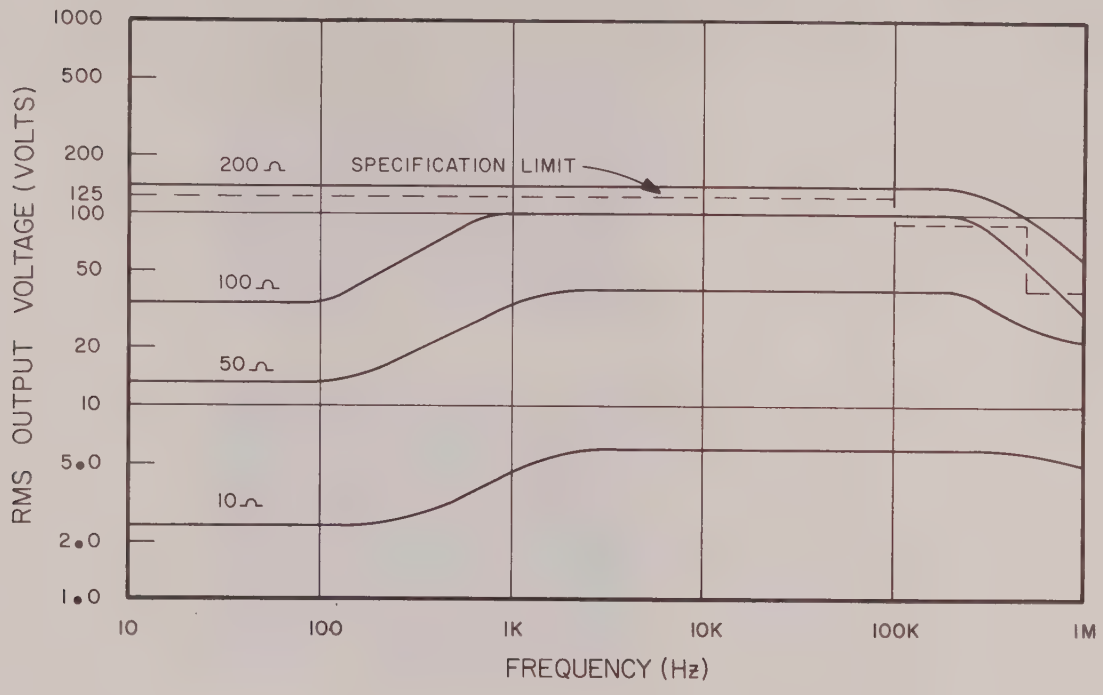


Figure 3. Typical RMS Voltage Output vs. Frequency for Different Resistive Loads.

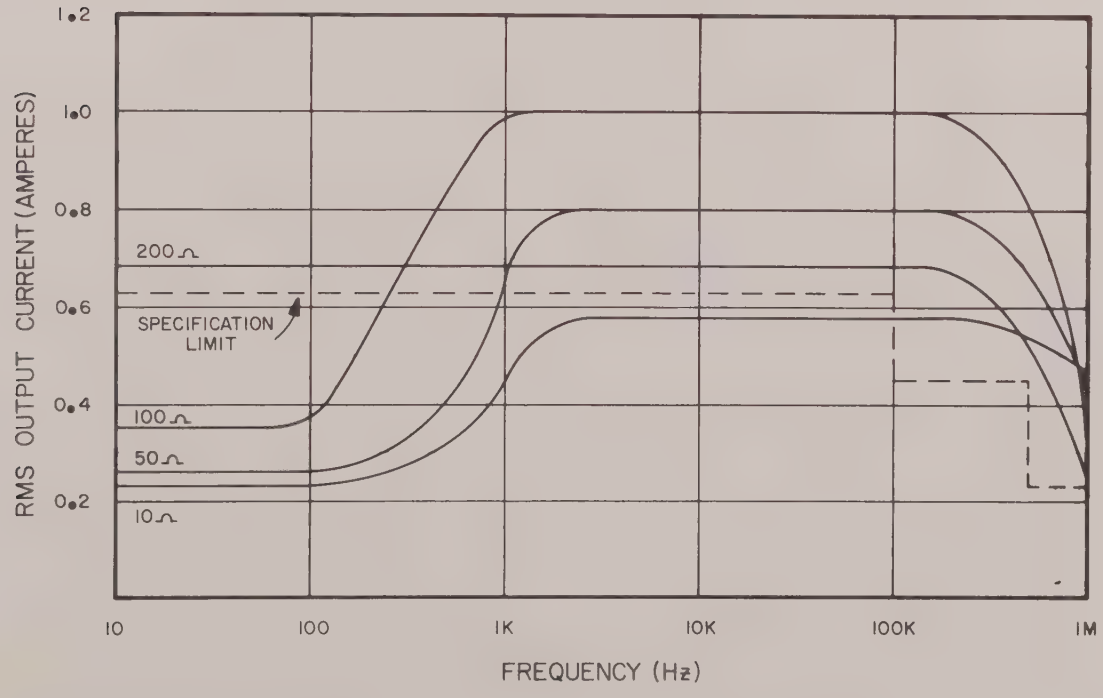


Figure 4. Typical RMS Output Current vs. Frequency, for Different Resistive Loads.

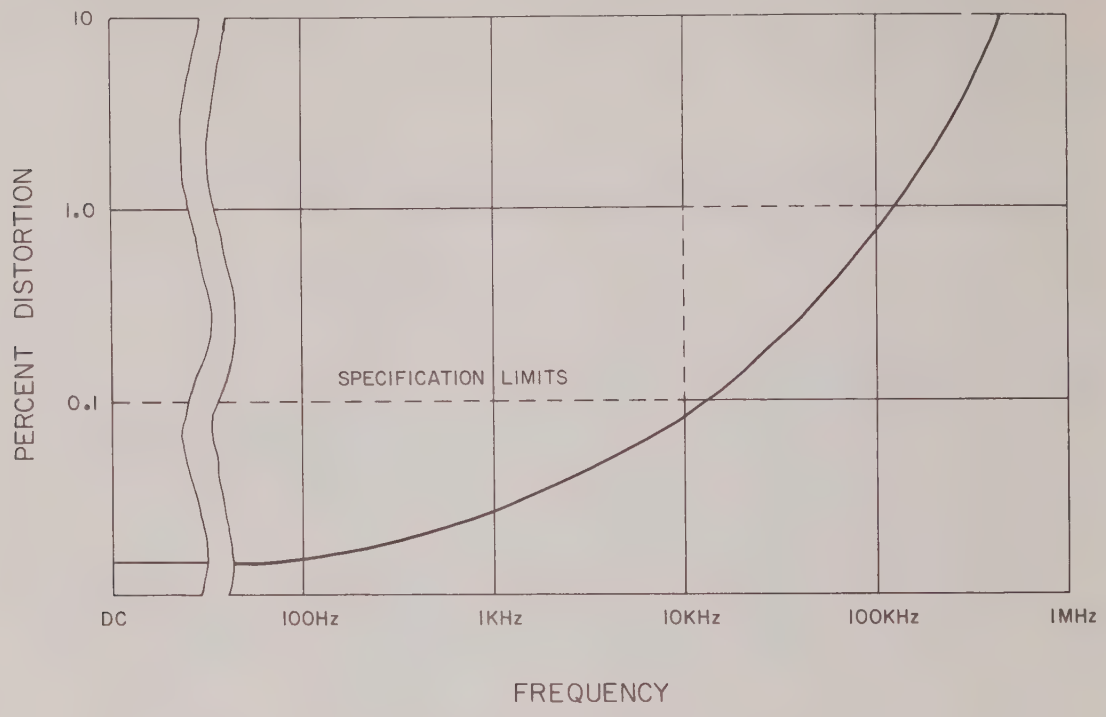


Figure 5. Typical Distortion vs. Frequency at Full Power Output.

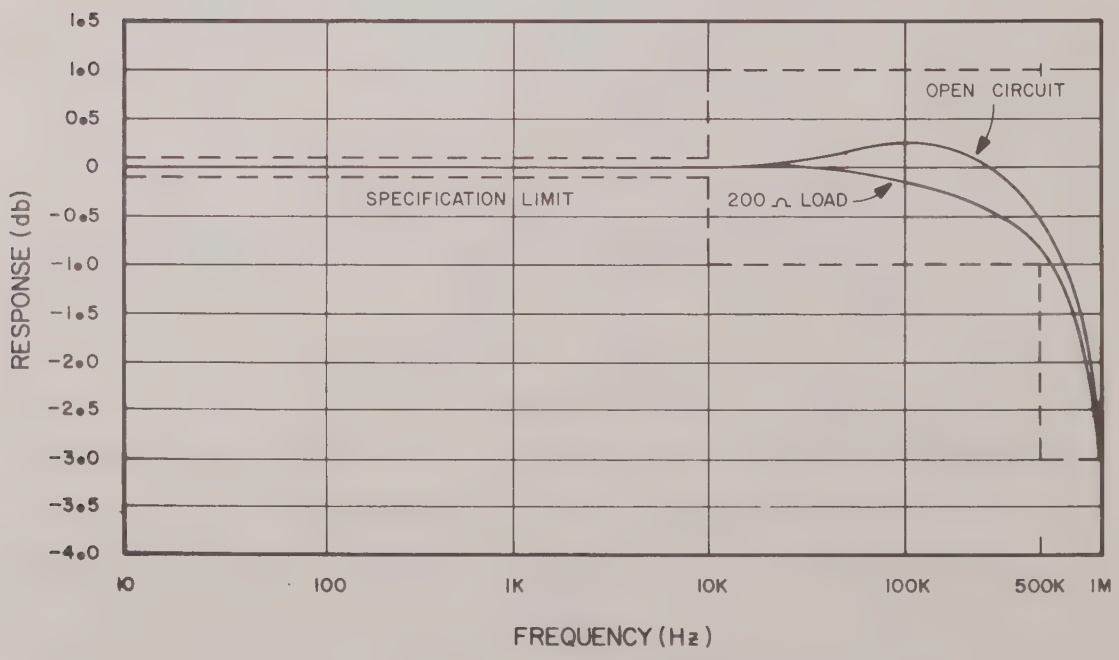
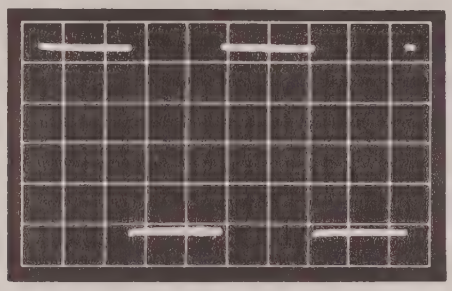


Figure 6. Typical Frequency Response

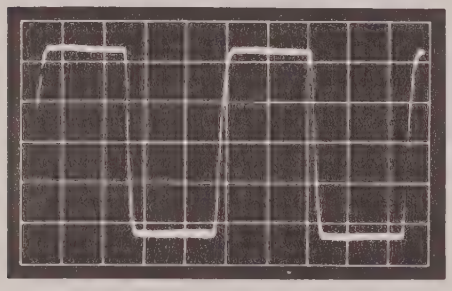
(a)



Amplifier Input

Vertical: 0.2 V/cm
Horizontal: 2 μs/cm

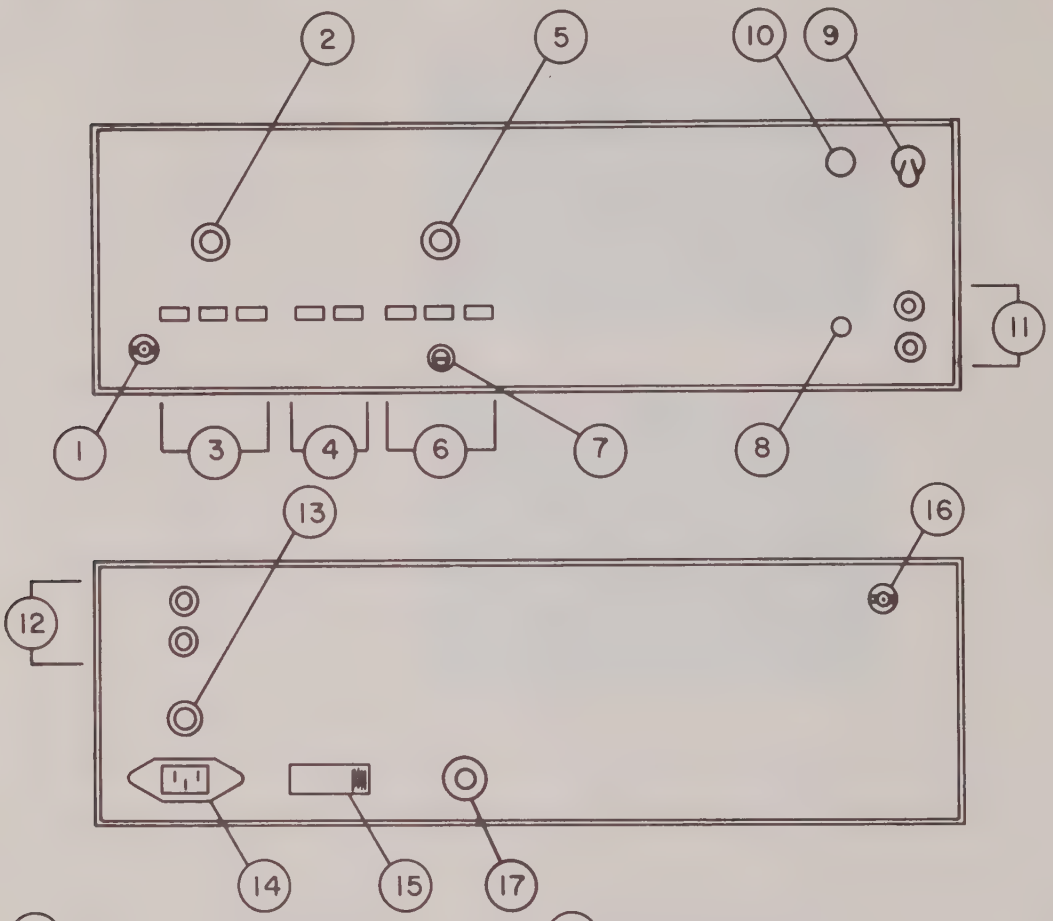
(b)



Amplifier Output

Vertical: 20 V/cm
Horizontal: 2 μs/cm

Figure 7. Response to Square Wave Input



1. FRONT INPUT (BNC)
2. VARIABLE GAIN CONTROL
3. OUTPUT GAIN SELECTOR SWITCHES
4. AC/DC INPUT COUPLING SELECTOR SWITCHES
5. VARIABLE DC OFFSET CONTROL
6. OUTPUT DC OFFSET SELECTOR SWITCHES
7. OUTPUT DC LEVEL SCREWDRIVER ADJUST
8. OUTPUT OVERLOAD INDICATOR
9. POWER SWITCH
10. POWER-ON INDICATOR
11. FRONT OUTPUT(BINDING POSTS)
12. REAR OUTPUT (BINDING POSTS)
13. FUSE
14. AC POWER RECEPTACLE
15. CHASSIS/FLOATING GROUND SWITCH
16. REAR INPUT (BNC)
17. CHASSIS GROUNDING POST

Figure 8. Operating Controls, Connectors and Indicators.

SECTION 2

OPERATION

2.1 POWER REQUIREMENTS

The Model 7500 Power Amplifier may be wired for operation from a single phase, AC power source of either 105-125 volts, 50-400 Hz, or 210-250 volts, 50-400 Hz. When the amplifier is wired for 105-125 volt operation, the power transformer's primary windings are connected in parallel by installing jumpers between pins 1 and 3, and pins 2 and 4, which are located on the transformer (figure 9a). A 5 ampere, slow-blow fuse is required for 105-125 volt operation. When 210-250 volt operation is required, the primary transformer windings are connected in series by placing a jumper between pins 2 and 3 (figure 9b). When the amplifier is wired for 210-250 volt operation, a 2.5 ampere, slow-blow fuse must be used.

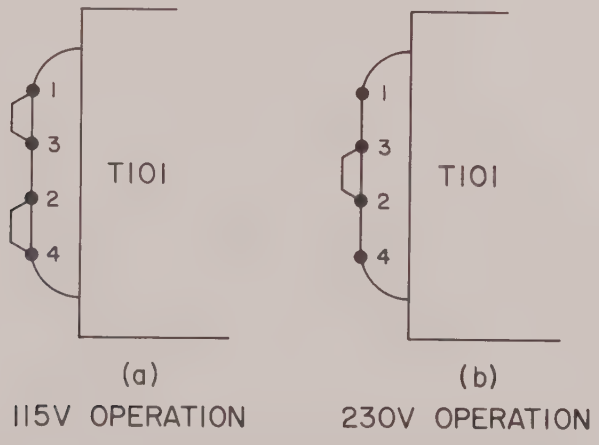


Figure 9. AC Input Wiring Diagram

2.2 OPERATING CONTROLS, CONNECTORS AND INDICATORS (See figure 8)

2.2.1 Front Panel Controls

POWER: ON-OFF toggle switch.

GAIN: 3 position push-button switch plus single-turn potentiometer for adjusting the amplifier's output voltage gain. The GAIN control provides a 20 db (×10) and 40 db (×100) fixed gain mode, plus a zero to 40 db variable mode.

INPUT COUPLING: 2 position push-button switch for selecting direct (DC) or capacitive (AC) coupling. In the AC mode, the low-cutoff frequency is approximately 1 Hz.

OUTPUT OFFSET: 3 position push-button switch for selecting zero, (+) or (-) DC offset, plus a single-turn potentiometer for controlling the offset from zero to 200 volts peak, open-circuit.

ZERO ADJ: Single turn screwdriver control for adjustment of the amplifier's output DC level.

2.2.2 Rear Panel Controls

CHASSIS/FLOATING: 2 position slide switch that disconnects the amplifier's signal ground (⏚) from its chassis ground (⏚), when used in the FLOATING mode.

2.2.3 Connectors

FRONT PANEL: BNC for INPUT, binding posts for OUTPUT.

REAR PANEL: BNC for INPUT, binding posts for OUTPUT; AC power receptacle, chassis grounding post.

2.2.4 Indicators (Front Panel Only)

POWER-ON: Neon indicator that lights to indicate a power-on condition.

OVERLOAD: Neon indicator that lights when the amplifier's output voltage approaches clipping as a result of an output overload.

2.3 OPERATION

2.3.1 Initial Set-Up

To operate the 7500 power amplifier, proceed as follows:

1. Make appropriate power connections (Section 2. 1).
2. Set the OUTPUT OFFSET control to zero.
3. Set the GAIN selector to the VARIABLE position and the GAIN potentiometer to the Max. CCW end.
4. Set the INPUT COUPLING switch to the desired mode.
5. Connect a voltmeter to the OUTPUT and adjust the OUTPUT DC level by means of the front panel ZERO ADJ screwdriver control.

Select the desired GAIN and OFFSET modes, and make the appropriate connections to the INPUT and OUTPUT connectors.

Allow a 30 minute warm-up to obtain rated performance specifications.

CAUTION!

The 7500 is capable of as much as 200 volts peak on its OUTPUT terminals. To prevent the possibility of electrical shock, extreme caution should be used in connecting or disconnecting any cable or load from the amplifier's OUTPUT terminals, whenever these voltages are present.

2.3.2 Gain Control

The GAIN control on the 7500 consists of a 3 position, push-button switch that selects 20 db (10) or 40 db (100) of fixed gain, or zero to 40 db of variable gain controlled by a single-turn potentiometer. The output voltage of the 7500 is in phase (non-inverted) with respect to the input, in all three GAIN modes. A minimum input signal of 1.5 volts RMS is required to obtain a maximum output voltage of 140 volts RMS in the 40 db FIXED or zero to 40 db VARIABLE positions.

CAUTION!

The maximum allowable input voltage is ±20 volts peak in the VARIABLE and ×100 GAIN positions, and ±200 volts peak in the ×10 GAIN positions.

2.3.3 Output Offset Control

The OUTPUT OFFSET control consists of a 3 position, push-button switch that selects zero, positive or negative DC offset. The positive or negative offset is controlled by a single-turn log taper potentiometer and is adjustable from zero to ±200 volts peak, open-circuit. The amplifiers output can be offset ±200 volts DC plus AC peak. That is, if the amplifier's AC output is 50 volts peak, then the signal may be offset by 150 volts maximum. The smaller the AC peak value, the greater the DC offset value. If no AC signal is applied to the amplifier's input, then the DC offset will provide a DC voltage on the amplifier's output, adjustable from zero to ±200 volts, open-circuit. In this condition, the amplifier may be used as an auxiliary DC supply, within the amplifier's specified limitations for voltage and current.

2.3.4 Reactive Loads

The 7500 is capable of driving capacitive and inductive loads within its voltage and current limitations. The 7500 will provide a minimum of 75 volt-amperes for a minimum load impedance of 200 ohms over most of its range.

2.3.5 Output Circuit Protection

The 7500 uses a modified form of foldback-current limiting to protect its output stages from damage caused by short-circuit or abnormal loads. Unlike a constant-current limiter, the circuit used in the 7500 varies the output limiting current as a function of output voltage, load and frequency. When the circuit limit is engaged, the front panel OVERLOAD indicator will light. Figure 10 shows typical current-limiting values for several resistive loads.

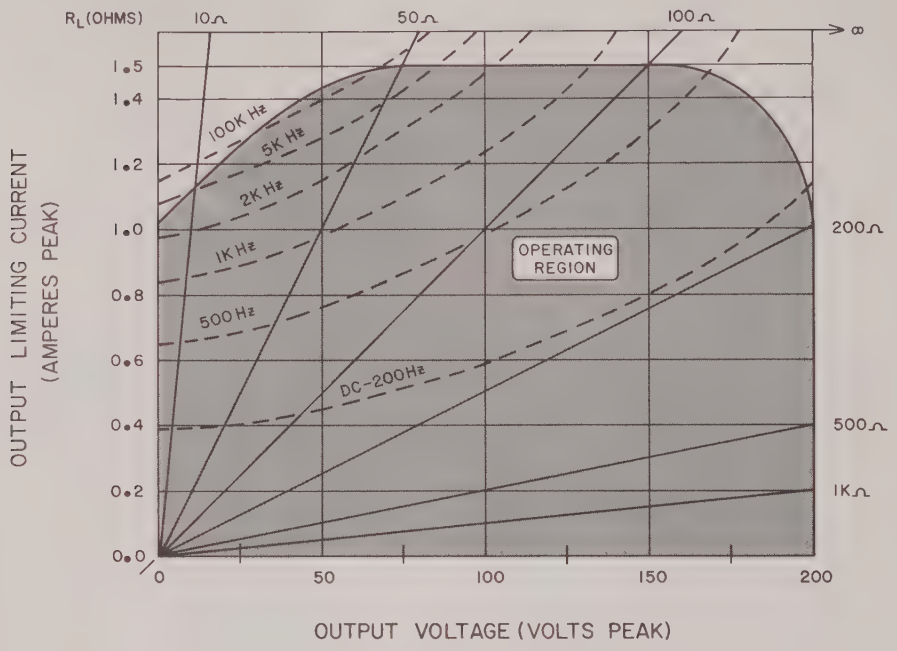


Figure 10. Output Current Limiting

The shaded area of the graph represents the amplifier's maximum operating region. Note that the peak limiting current is reduced at peak voltages below 75 volts (resistive loads below 50 ohms). Hence the name "foldback limiting." The load lines on the graph are drawn from the origin (0.0/0) and are labeled on the edges of the graph which consists of a linear scale, in ohms, that extends to infinity. The 200, 500 and 1K ohm load lines are extended only to where they intercept the limiting voltage.

The maximum power output of the amplifier is determined by the peak power dissipated in the output transistors. Since the output stage operates in a class B mode, the peak power can be averaged over a full cycle at high frequencies. For resistive loads of 200 ohms or greater, the power dissipated in the output stage is low enough to allow the amplifier to provide its full output voltage swing at all frequencies.

The amplifier's limiting current is dependent upon frequency, as indicated by the dashed lines on the graph, which are related to the thermal time constant of the output transistors. The limiting current will be determined by the point where the load line intersects the frequency curve. For example, with a 100 ohm load, the output current is limited to approximately 400 ma at frequencies below 200 Hz (essentially DC), and limited to 1 ampere up to about 500 Hz. Above 500 Hz, the output current can increase until its maximum limiting value is reached.

SECTION 3

INCOMING ACCEPTANCE AND PERFORMANCE CHECKS

3.1 INTRODUCTION

The following procedure is provided to insure that the Amplifier is operating within its rated specifications, both for incoming inspection and for routine servicing. Tests should be made with all covers in place, and the procedure given below should be followed in sequence. Refer to Section 2, Operation, before beginning this procedure.

3.2 TEST EQUIPMENT REQUIRED

(a) Oscilloscope, bandwidth of at least 50 MHz, vertical sensitivity from 5V/cm to 50V/cm, Tektronix type 465, or equivalent, with probe.

(b) Low Distortion Oscillator, frequency range .01 Hz to 1 MHz, output voltage at least 1.5 volts RMS, and harmonic distortion less than .02% to 10 KHz and less than 0.1% to 100 KHz, Krohn-Hite Model 4100A or equivalent.

(c) RMS Voltmeter, Fluke Model 931A or equivalent.

(d) AC Voltmeter, Ballantine Model 314A or equivalent.

(e) Digital Voltmeter (DVM) to measure up to ±250 volts DC.

(f) Resistive load, 200 ohms, 100W, 5%, non-inductive.

3.3 INITIAL SET-UP

After allowing the instrument to warm up for at least 30 minutes, set the 7500 controls to the following positions:

GAIN	Variable, Pot Max CCW
INPUT COUPLING	DC
OUTPUT OFFSET	0, Pot Max CCW
GROUND	Chassis

CAUTION!

The 7500 is capable of providing as much as 200 volts peak on its OUTPUT terminals. To prevent the possibility of electrical shock, extreme caution should be used in connecting or disconnecting any cable or load from the amplifier's OUTPUT terminals, whenever these voltages are present.

3.4 POWER OUTPUT, VOLTAGE AND CURRENT

The power output of the 7500 can be measured by a standard wattmeter. If a wattmeter is not available, an alternative method, illustrated in Figure 11 may be used.

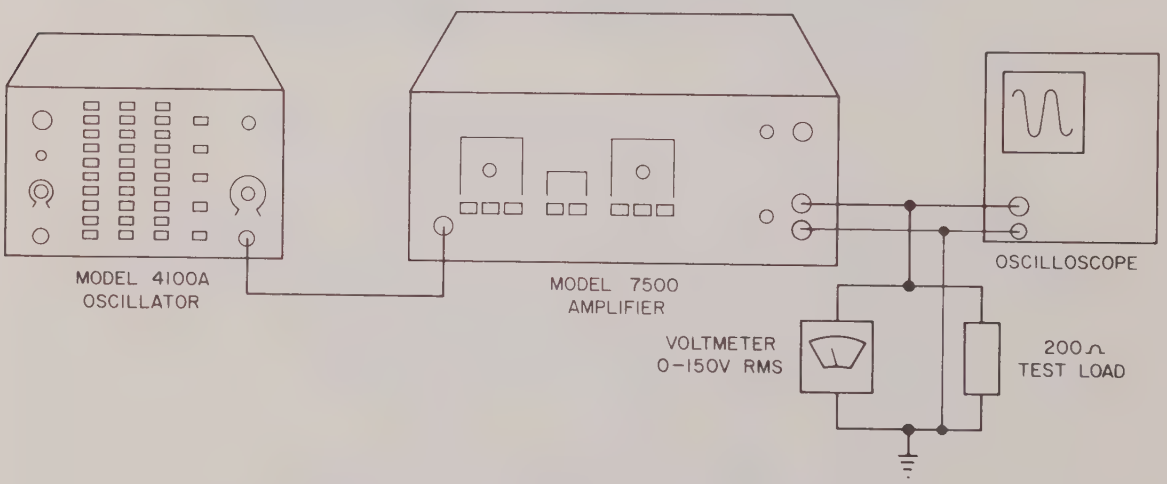


Figure 11. Test Setup for Measuring Power Output

The Amplifier's maximum power output is obtained with a 200 ohm resistive load. First adjust the output of the oscillator to approximately 1.5 volts RMS, then increase the Amplifier's VARIABLE GAIN control while monitoring the scope, until a maximum output signal is obtained; make sure the signal is not clipped or distorted. The maximum power output, in watts, can now be calculated from the expression,

$$P_{avg} = \frac{E^2_{RMS}}{R_L}$$

The values for maximum output current are obtained from the relation,

$$I_{RMS} = \frac{E_{RMS}}{R_L}$$

Refer to Figures 2, 3 and 4 for typical values of output power, voltage and current, respectively, for various resistive loads.

3.5 FREQUENCY RESPONSE

The frequency response of the Amplifier is defined as the variation in output voltage, Δe_o, vs frequency, for a constant input, and may be expressed either in percentage or db as follows:

$$\% \text{ deviation} = \frac{\Delta e_o}{e_o} \times 100\%; \qquad db = 20 \log \frac{e_o + \Delta e_o}{e_o}$$

Refer to Figure 6 on Page 6 for typical characteristic curves.

When performing the response measurements, the Amplifier's output voltage should be kept within its maximum output limitations over the entire frequency range. A recommended procedure is to set the Amplifier's GAIN control to ×100, DC coupled, and adjust the oscillator's output voltage for approximately 10 volts RMS on the Amplifier's output. A suitable Voltmeter, such as the Model 931A, should be used, since it allows greater resolution of small amplitude variations. The oscillator output should be kept constant at all times. Measure the response of the Amplifier from approximately 100 Hz to about 10 KHz; amplitude variation should be less than ±100 mv RMS (±1%). Tune the oscillator from 10 KHz to about 500 KHz; amplitude variations should be within ±1 volt RMS. Increase the frequency of the oscillator; the Amplifier's output voltage should drop to 7 volt RMS at approximately 1 MHz.

3.6 HARMONIC DISTORTION

Connect the 200 ohm test load to the Amplifier's output and adjust the oscillator's output voltage for 122.5 volts RMS on the Amplifier's output (75 watts). Measure the distortion at several frequencies, using the HP333A Distortion Analyzer; the distortion should be less than 0.1% up to 10 KHz, and less than 1% up to 100 KHz. Monitor the Amplifier's output signal on the scope to make sure it is not clipped or distorted.

3.7 VOLTAGE GAIN, FIXED MODE

Set the frequency of the oscillator to approximately 1 KHz and adjust its output voltage for exactly 1 volt RMS. Switch the Amplifier's GAIN control to the ×10 position, and measure the voltage on the output terminals. Tolerance: 10V ± 0.2V RMS.

Switch the Amplifier' s GAIN control to the ×100 position and measure its output voltage.

Tolerance: 100V, ±2V RMS. (Recheck the Amplifier's input when switching from ×10 to ×100.)

3.8 OUTPUT REGULATION

Output regulation is defined as the Amplifier's percentage change in its output voltage, when a 200 ohm load is connected to the output terminals. Set the oscillator frequency to 1 KHz and adjust the oscillator' s output voltage for 100V RMS on the Amplifier's output. Connect the 200 ohm test load and observe the change in output voltage. Tolerance: less than 0. 5%. Disconnect the oscillator.

3.9 DC OFFSET

Short the input to the Amplifier and connect a DC Voltmeter to the Amplifier's output. Switch the Amplifier's OFFSET control to "+" and adjust the variable OFFSET control to its maximum clockwise position. The output DC offset should be greater than +200V.

Switch the OFFSET control to the "-" position. The output DC offset should be greater than -200V. Return the OFFSET control to the "0" position.

3.10 OUTPUT HUM AND NOISE

The Amplifier's internally generated hum and noise can be measured with a Ballantine 314A Voltmeter. Short the Amplifier's input and measure the hum and noise on the Amplifier's output. Tolerance: less than 4 millivolts RMS.

Remove the short and connect a suitable shield to both the Amplifier's front and rear input terminals. Measure the output hum and noise. Tolerance: less than 10 millivolts RMS.

3.11 SQUARE WAVE RESPONSE

The typical square wave response of the 7500 is shown in Figure 7, Page 7.

SECTION 4

CIRCUIT DESCRIPTION

4.1 INTRODUCTION

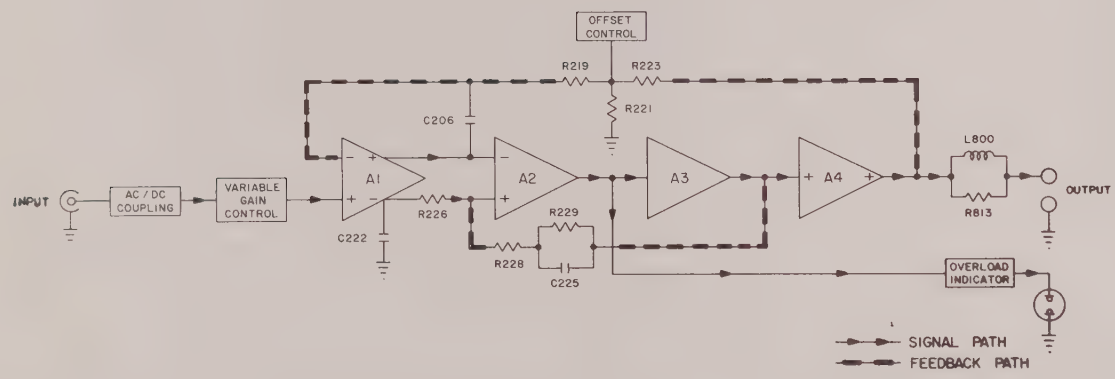


Figure 12. Simplified Block Diagram

A simplified block diagram of the Model 7500 is shown in Figure 12. The basic amplifier circuit consists of: a differential input-balanced output amplifier stage (A1); a differential input-single ended output second stage (A2); a class A driver stage (A3) and a class B, push-pull emitter follower output stage (A4). The amplifier's main feedback is taken from the output of A4 and fed back degeneratively to the complementary input of A1. Supplementary feedback paths are added within the gain stages for stabilization at high frequencies and to shape the amplifier's open loop gain vs frequency. The amplifier is DC coupled throughout. The overall gain of the amplifier is 40 db and is non-inverting.

4.2 INPUT COUPLING AND VARIABLE GAIN CONTROLS

The 7500 provides either direct (DC) or capacitive (AC) input coupling as selected by S202. In the AC coupled mode, the low frequency cutoff occurs at approximately 1 Hz. The gain of the amplifier is controlled by S201 and R200. In the X100 position, the input signal is fed directly to the first stage, and the gain is fixed at 40 db. In the X10 position, the input signal is first attenuated by a factor of 10:1, and then fed to the input stage, resulting in a fixed gain of 20 db. In the VARIABLE position, the input signal is applied to R200, and then to the input stage, resulting in a continuously variable gain from zero to 40 db.

4.3 INPUT STAGE (See figure 13)

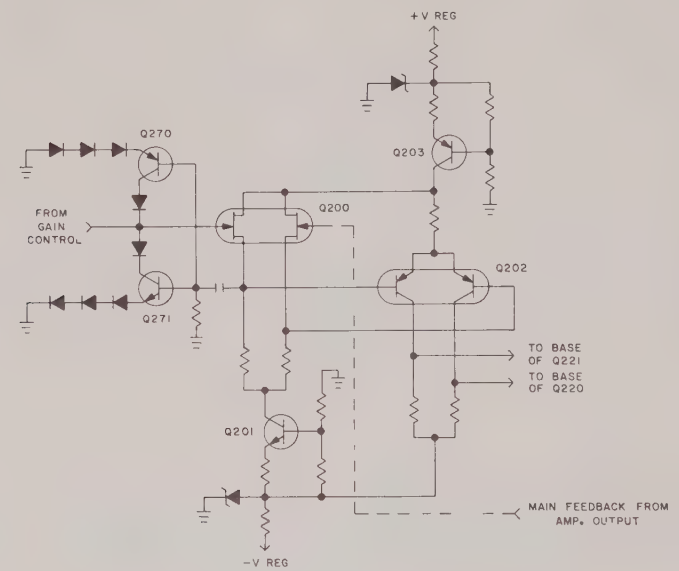


Figure 13. Input Stage

The input stage consists of a dual, monolithic FET, Q200, connected as a pair of source followers which drive the inputs of dual transistor, Q202. The use of transistors Q201 and Q203 as zener-stabilized constant-current sources provide the input stage with its near-ideal differential operation, resulting in low thermal drift and high common-mode rejection. A degenerative feedback path is connected from the amplifier's output to the complementary input of the dual FET which minimizes non-linearities (distortion) and provides the amplifier with its non-inverting voltage gain. The balanced output signal developed on the collectors of Q202 is used to drive the second stage.

The OUTPUT OFFSET and OUTPUT DC LEVEL controls are connected to the feedback gate of Q200. The OUTPUT OFFSET control is wired in a special manner to prevent damage to the unit if the "+" OFFSET and "-" OFFSET buttons are pushed simultaneously.

Transistors Q270 and Q271 prevent excessive input voltage levels from damaging the Amplifier.

4.4 SECOND STAGE (See figure 14)

The second stage consists of a differential amplifier Q220 and Q221, transistor, Q223, and a zener-stabilized, constant current source, Q222. The differential output from the first stage is applied to the bases of Q220 and Q221. The output of the second stage is taken from the collector of Q220, and is applied to the emitter of Q223. Q223 functions as a grounded base amplifier and isolates the second stage from the positive supply voltage. The signal developed at the collector of Q223 feeds the input of the driver stage, which is sitting close to +240 volts.

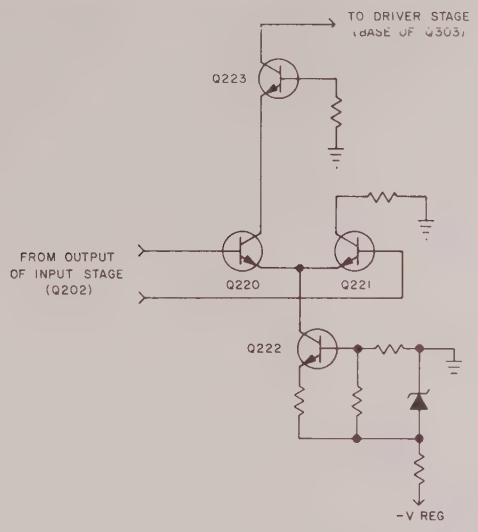


Figure 14. Second Stage

4.5 DRIVER STAGE (See figure 15)

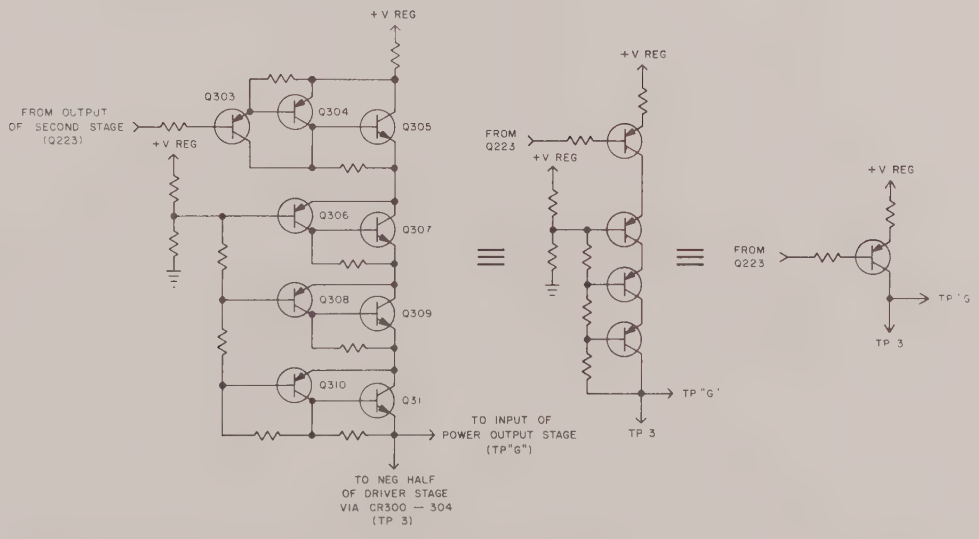


Figure 15. Driver Stage, Illustrating Equivalent Network

Because of the high power and voltage requirements, a special transistor configuration is used in the driver stage. Transistors Q303 and Q304 are connected as a Darlington pair that in turn drive a high-power NPN emitter follower, Q305. The resultant configuration is equal to that of a high power PNP transistor. The output of the second stage (collector of Q223) is applied to the base of this "virtual PNP" transistor. Three similar "virtual PNP" transistors are connected in a voltage sharing series string with the "collector" of the first "PNP." The bases of each "PNP" are connected to a voltage divider to the +240V supply resulting in equal voltage and power distribution across the string.

The negative half of the driver stage operates in a similar fashion, and consists of NPN transistors. The current in the negative string is determined by divider network R416 and R419, and by the emitter resistor of Q407.

At low to mid frequencies, the driver stage operates as a class A, common-emitter amplifier (positive half) with a constant-current source (negative half). At higher frequencies, capacitor C307 and C308 provide additional drive to the current source, converting the driver stage to push-pull operation. A passive network between the collector of Q305 and +240V shapes the response of the driver stage at higher frequencies. A similar network does the same for the negative half.

4.6 OUTPUT STAGE (See figure 16)

The output stage operates as a dual class B PNP-NPN high power emitter follower. The signal from the driver stage goes to the bases of Q615 and Q700 and also to the center of a resistive voltage divider between + and - supplies. Q615 and Q700 each drive a group of 4 parallel connected power transistors. Taps on the voltage dividers drive other groups of power transistors — 3 groups each for the positive and negative side. Each group consists of 4 power transistors and a driver transistor, the power transistors being cascaded as shown on the schematic. With these 8 groups of transistors connected in series between plus and minus power supplies, the voltage between the amplifier output and the power supply is evenly divided among the 4 groups. Current is divided among the 4 transistors in each group, so that dissipated power is also equalized among the 16 power transistors on each polarity of the output. It should also be noted, that each heat sink carries two transistors from each side of the output; even with heavy DC load the dissipated power will be equalized.

4.7 POWER SUPPLY (See figure 17)

The power supply provides ±240 volts of regulated power to the amplifier's gain stages, and ±300 volts of unregulated power for the amplifier's output stage. The plus and minus 300 volts are taken directly from the output of the AC bridge rectifier and filter capacitors. The output of the bridge rectifier is also applied to the plus and minus regulator circuits, which in turn provide the ±240 volts regulated. The plus 240 volt supply is independent of the minus 240 volt supply. For simplification, only the plus 240 volt supply will be discussed in detail. (Continued on page 22.)

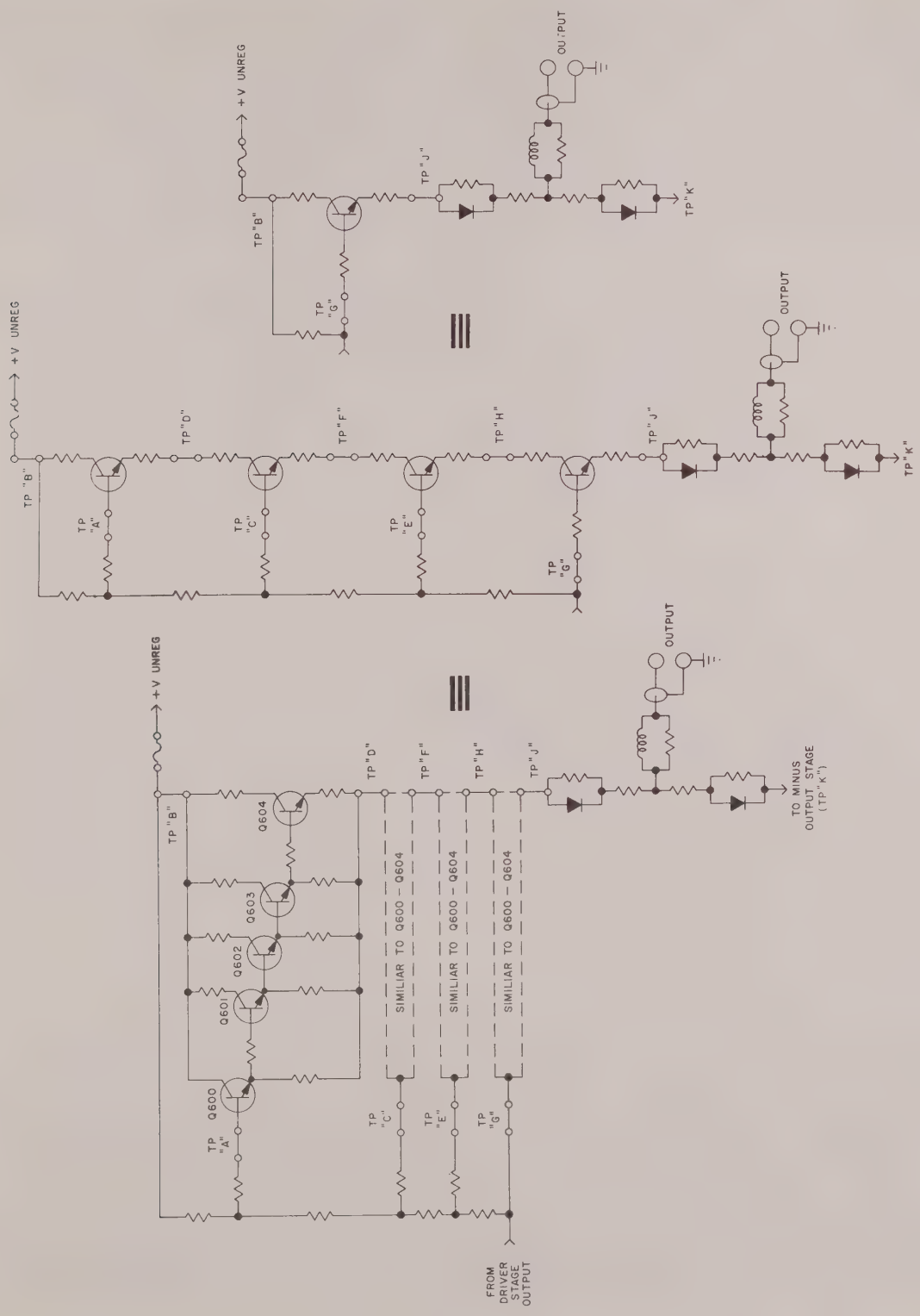


Figure 16. Output Stage, Illustrating Equivalent Network

4.7 POWER SUPPLY (Cont)

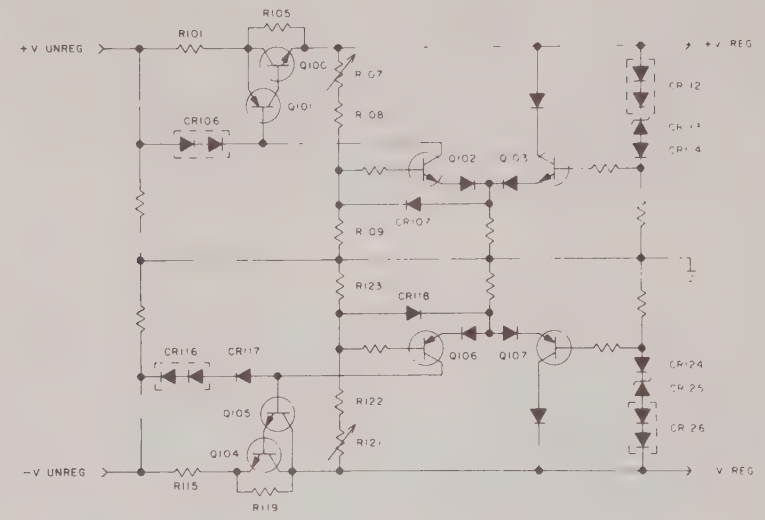


Figure 17. Power Supply

The plus regulated supply consists of a series regulator, Q100, a driver, Q101 and a sense amplifier, Q102 and Q103. CR112, CR113 and CR114 provide the reference voltage for the sense amplifier, which is applied to the base of Q103. Part of the supply voltage is applied to the base of Q102 through divider R107, R108 and R109. Any variations in the regulated supply voltage will create an error signal that will be fed back to the sense amplifier, which will, in turn, feed the driver and control the series regulator to compensate for the variation. CR107 is used to provide start-up current when the amplifier is turned on. A short-circuit or excessive load on the +240 volt supply will increase the voltage across current-sensing resistor, R101, and clamp the base-emitter drive of Q101 through CR106 thereby limiting the current. The -240 volt supply operates in a similar manner.

4.8 PROTECTIVE CIRCUITS

There are several means of overload protection in this amplifier.

The line fuse primarily protects the power transformer.

The 1A fast-blow fuses on the circuit boards will protect the output stages against sustained overloads, but are not fast enough to be effective for large shorttime current spikes. (The thermal time constant of the output transistors is in the order of 1 millisecond).

Q800 and Q801 with associated circuit elements provide overcurrent protection. If the voltage drop across the sensing resistors R800 to R807 exceeds the base-to-emitter turn-on voltage of either Q800 or Q801, Q800 or Q801 will be turned on and short the driver through its associated diode, namely CR802 or CR803.

Excessive driver current is limited by the networks containing Q300, Q301, and Q302 for the positive half wave, and Q408, Q409 and Q410 for the negative. These circuits will be activated by an abnormal increase in driver current, such as would happen if the output of the driver is clamped by any of the other protection circuits.

The increased current flowing in R308 (R414 for the negative swing) would create a voltage drop sufficient to turn on transistor Q307 (Q409), which would clamp the driver input through emitter follower Q300 (Q408). A short time delay is provided by R307 and C300, (R415 and C405) to prevent activation of this circuit by very short spikes, such as would occur at this point with a square wave or pulse input.

At frequencies that are low compared to the thermal time constant of the output transistors, the peak power dissipation determines the allowed operating conditions. At higher frequencies the dissipated power can be averaged over a cycle — more power output can be allowed. The same applies also to the limits imposed by the secondary breakdown condition. The load impedance, or the instantaneous ratio between output voltage and current must also be considered. In an abnormal load condition, R808 to R810 (4 ohm) act as the current sensing resistor. The voltage drop across this resistor will tend to turn off Q900 (Q902 for the negative half-cycle) and turn on Q901 (Q902) which will clamp the driver through diode CR900 (CR901). The output current at which this happens at low load impedance (10 ohm), low frequency (10 Hz) is set by potentiometer R501 (R508).

If the load impedance is increased, the output voltage swing for the same current will be larger. This will reduce the voltage drop across the output transistors, lowering dissipation — so higher load current could be tolerated. This is accomplished by the voltage divider R504 (R511) and the resistance at the center arm of the potentiometer R501 (R508). Higher voltage swing will oppose the action of the load current in triggering the protective circuit.

At still higher impedance loads diode CR500 (CR501) will be turned on (at about 120V peak), further depressing the protective action, the result being a broken limiting characteristic that hugs the low frequency limit curve quite closely.

At higher frequencies (above 200 Hz) the limits are much wider (as discussed previously). This is achieved by the R-C networks R900, R503, C900, C680 (R901, R510, C901, C501) that shunt the overload signals. The result is a frequency dependence of the protection system that quite closely approximates the actual capabilities of the unit.

4.9 FEEDBACK AND LOOP STABILIZATION (See figure 18)

The 7500 employs a non-conventional technique for preventing loop instability. At low frequencies, the negative feedback loop is connected from the amplifier's output, through feedback divider R223-R221 and R219 to the inverting input of Q200 (see Figure 18a). Around 2 kHz, the input to the second stage is grounded by C222. At the same time local feedback is introduced from the output of the driver stage to the base of Q221, via C225 and R221-228. R228 and R226 become the output local feedback divider, with the same loss as the overall feedback, namely 40 db. (See Figure 18b.) At even higher frequencies (around 100 kHz) capacitor C206 comes in, feeding back locally from the collector of Q202 to the gate of Q200. At this point, the original feedback loop R223, R221 and R219 has little effect and the amplifier's network now consists of an input amplifier with a gain of one and an output amplifier with a gain of 100 (see Figure 18c).

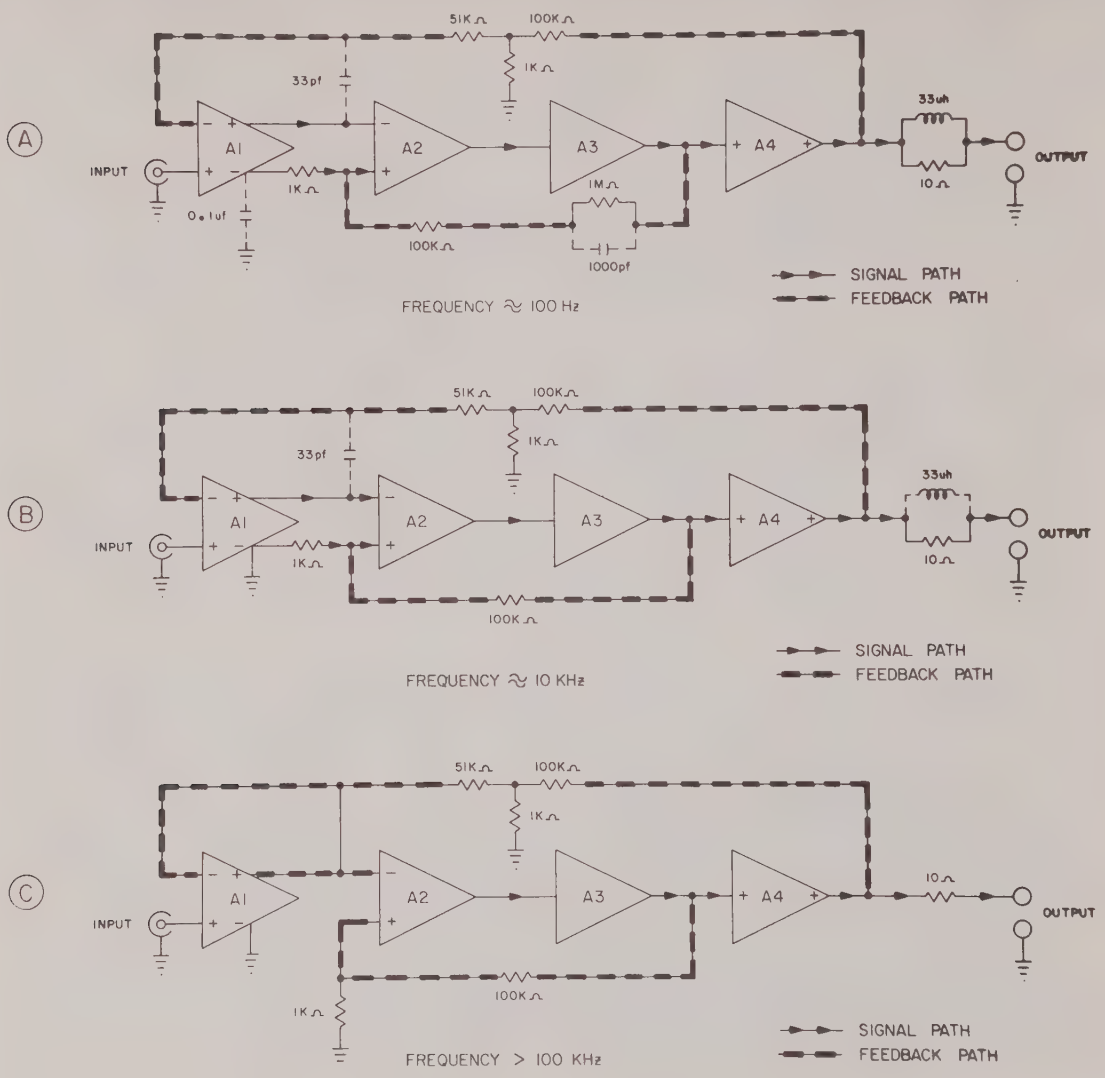


Figure 18. Feedback and Loop Stabilization

SECTION 5

MAINTENANCE

5.1 INTRODUCTION

If the amplifier is not functioning properly and requires servicing, the following procedure may facilitate locating the source of trouble. Access to the interior of the amplifier is accomplished by removing the four screws centered at the rear of each cover; sliding off the side covers will unlock the top and bottom covers.

When a malfunction is detected, first check the line voltage and line fuse, and then make an inspection for broken wires, burnt or loose components, poor solder joints or similar conditions which could cause trouble. Before beginning troubleshooting, it should be determined if the normal adjustments outlined in the Calibration Procedure, Section 6, will correct the trouble. Any troubleshooting of the amplifier will be greatly simplified if there is an understanding of the operation of the circuit; reference should be made to Operation, Section 2 and Circuit Description, Section 4.

5.2 TROUBLESHOOTING PROCEDURE

After removing the covers, a close examination of the wiring and circuit boards may often locate the source of trouble. Check for loose wires, or burnt or broken components. If this inspection does not reveal the cause of the trouble, voltage measurements will have to be made.

WARNING!

There are potentially dangerous voltages (as much as 350 volts) that exist at various locations within the amplifier's circuitry. To avoid the possibility of a severe shock, extreme caution should be used in making voltages measurements. Use of a well-insulated probe with minimum exposure of its tip will greatly reduce potential shock hazard, plus reduce the chance of the accidental shorting of components.

Before proceeding with the troubleshooting procedure, set the amplifier's controls to the following positions:

GAIN	Variable, Pot Max. CCW
OUTPUT OFFSET	Zero, Pot Max. CCW
INPUT COUPLING	AC

5.3 POWER SUPPLY

A malfunction in the power supply will sometimes be indicated by a blown fuse. Check the 5A/115V-2.5A/230V line fuse, located on the rear panel, and then the 1 ampere fast-blow fuses, located on the output stage circuit boards. If any of these fuses have blown, replace them and check to see if the power transformer has been wired for the proper line voltage (see Figure 9, Page 9). If the wiring appears to be correct, connect the power cord of the 7500 to a Variac and switch the amplifier's POWER switch to ON. Turn the Variac up slowly, and at the same time monitor the line current. If the current exceeds 2 amperes before the proper line voltage is reached, a short or overload is indicated somewhere in the circuitry. Return the Variac to zero, and remove the 1 ampere fast-blow fuses. Turn the Variac up again slowly; if the line current does not exceed 2 amperes, when the proper line voltage of 115V (or 230V, if applicable) is reached, then a malfunction in the output stages is indicated (Section 5.6). If the current still exceeds 2 amperes, however, a short or excessive overload is indicated, either in the power supply circuit, or on the power supply buses.

If the line current appears normal, check the unregulated voltages on the terminals of filter capacitors C104 and C105). Voltage should be approximately 300 volts. If it is not, then the power transformer and/or its associated components may be defective. If these voltages are okay, check the plus and minus 240V regulated supplies at the "+240V" and "-240V" test points, located on the input amplifier card, PC 753.

If these voltages are within 2% of their nominal value, and do not change when the output of the Variac is changed ±10%, then it can be assumed that the supplies are working properly. If these voltages are not correct, however, a malfunction is indicated. If either supply voltage is higher or lower than normal, an error voltage will be created that will be fed back through the supply stages to the series regulator, which will, in turn, compensate for the error. The defective component or components will be found at the point where this corrective action is blocked. For example, if the plus 240 Volt supply were lower than normal, it would cause the base of Q103 to go more negative, which in turn would cause its emitter to go more negative. The base of Q102 would become more negative, and in turn, its collector would become more positive. This would then reduce the base-emitter voltage of Q101, turning it off. The collector of Q101 would then go more negative, turning on Q100, and thereby compensating for the error. If the supply voltages are low, but a power supply malfunction is not apparent, there may be an overload elsewhere in the amplifier circuit.

5.4 INPUT STAGE

A malfunction in the input stage will usually result in a large DC voltage error on the output of the stage, at TP 1. To verify this, measure the voltage at TP 1 and TP 7. If the TP 1 voltage error is opposite in polarity to voltage at TP 7, then the input stage is defective. If the errors at TP 1 and TP 7 are of equal polarity, however, the problem is probably not in the input stage, but further on in the amplifier's network – either in the driver or output stages. If it is determined that the input stages are malfunctioning, then the use of level tracing should localize the problem. It should be kept in mind that the signal path will be through balanced stages, so that relative rather than absolute voltages are of importance. As an example, if the voltage at TP 1 is close to +240V, and TP 7 is negative, then the gate of Q200B should be more negative than the gate of Q200A (which sits at ground level). The base of Q202B should then be more negative than the base of Q202A, since they are connected to the respective sources of Q200A

and Q200B. The collector of Q202B should then be more positive than the collector of Q202A. The base of Q221 should then be more negative than the base of Q220. (The voltage divider on the base of Q221 should have little effect.) Since the emitters of Q220 and Q221 are equal, Q221 will be turned off, turning on Q220, which then turns on Q223, thereby pulling TP 1 more negative. The above would be the normal sequence of action. If TP 1 is sitting high instead of being pulled low, then a defective component is blocking the corrective action. Following the described signal path should locate the defective component or components.

5.5 DRIVER STAGE

Faults in the driver stage can, in most cases, be easily traced, if the circuit is visualized in its simple form. Transistors Q303 and Q304 are connected as a Darlington pair; they, in turn, drive Q305 which operates as an NPN emitter follower. The resultant configuration resembles a high-power PNP transistor (see Figure 15, Page 19). Three additional pairs of transistors are connected in a similar configuration; they in turn are connected in a voltage sharing string with the collector of the first "PNP" transistor. The positive half of the driver stage resembles a single, high-power PNP transistor, that operates as a class A, common emitter amplifier. The negative half of the driver stage is connected in a similar fashion, and operates as a constant current source for the positive half.

A malfunction in the driver stage can now be verified by the use of level tracing. For example, if the voltage at the base of the "PNP" (positive half of the driver stage) is higher than normal, then the "collector" should sit lower than normal. The same method can be used for the negative half of the driver stage. Once the problem is localized to a particular stage, it is a simple matter to isolate the defective component or components. Since the transistors pairs are connected in a voltage-sharing string, the voltage drops across each pair should be approximately equal. If the collector to emitter voltage of one or more transistor pairs is abnormally high or low, then a defective transistor or transistors may be suspected.

Since the driver stage is converted to push-pull operation at high frequencies (Section 4.5) a malfunction of the stage at the high frequencies may be localized to capacitors C307 and C308, which provide the additional signal drive at high frequencies for the negative half of the driver. Check for poor solder connections or broken or loose leads.

5.6 OUTPUT STAGE

The structure of the output stage — groups of four power transistors that are essentially in parallel and stacked in four groups in series on each side of the class B amplifier — is equivalent to a pair of very high power NPN-PNP emitter followers (see Figure 16, Page 21). If the 1 ampere fast blow fuses are removed, these followers lose their power supply, but are still connected to the driver stage. An input signal will still get through to the amplifier's output, with near-normal gain, but with much less power.

If the 1 ampere fuses have been blown, there is an indication that there is a fault in the output power stage. To troubleshoot the output stage, replace each 1 ampere fuse with a 50 ohm, 50W power resistor. Turn the Variac up slowly, and monitor the line current; do not let the current exceed 2 amperes. Check the voltages on test points B, D, F, H and J, and U, S, P, M and K; the voltage division across the plus or minus half of the output stage should be in approximately equal increments. If the voltage between two successive points is much lower than the others,

then at least one transistor in that group is probably defective. To localize the specific transistor, check the voltage drop across each of the 1 ohm resistors in series with the collectors of these transistors. A defective or shorted transistor will show a considerably higher voltage drop across its respective 1 ohm resistor. (For sections H-J and M-K, check the drop across the 4.7 ohm resistor.) After replacing a defective transistor, continue with the voltage measurements until all the defective components have been replaced. Next, connect a 1 kHz signal to the amplifier input, and check the maximum output voltage, both open-circuit and with load, (about 200 ohms). Leave the 50 ohm 50W resistors in for this step. If the amplifier appears to be working satisfactorily, proceed to Section 6, Calibration, to verify the amplifier's performance specifications, and to make any necessary adjustments.

5.7 PROTECTION CIRCUITS

A malfunction in one of the protection circuits may be sometimes difficult to localize, so it will be necessary to disconnect the circuits one at a time.

WARNING!

Extreme care should be exercised when operating the amplifier with the protection circuits disconnected. An overload, even only for a short time can seriously damage a number of the high-power transistors in the output stage!

Disconnecting diodes CR802 and CR803 will remove the positive and negative output current limiting circuits.

Disconnecting CR900 and CR901 will remove the frequency dependent bridge limiting circuits.

Disconnecting the emitters of Q300 and Q408 and collector resistors R303 and R418 will remove the driver stage current-limiting circuit.

After localizing the problem to a particular circuit, a few simple voltage measurements should point to the faulty component or components. Advantage can be taken of the amplifier's OUTPUT OFFSET feature, to check the operation of each limiting circuit.

SECTION 6

CALIBRATION

6.1 INTRODUCTION

The following procedure is provided to facilitate the calibration and adjustment of the amplifier in the field, and adherence to this procedure should restore the amplifier to its original specifications. If the amplifier cannot be calibrated by the procedure given, refer to Section 5, Maintenance. If any questions arise which are not covered by this procedure, please consult our Factory Service Department. The location of all major components, sub-assemblies, test points, screwdriver controls and adjustments are illustrated on the schematic drawing at the rear of this manual.

Access to the interior of the amplifier is accomplished by removing the four screws centered at the rear of each cover. Removing the two side covers will unlock the top and bottom covers, which may then also be removed.

6.2 TEST EQUIPMENT REQUIRED

The following test equipment is required to perform the calibration procedure:

1. Oscilloscope, bandwidth of at least 50 MHz, with vertical sensitivity from 5mv/cm to 50V/cm, Tektronix type 465 with probe, or equivalent.

2. Sine/square generator, frequency range 10 Hz to 10 MHz, output voltage adjustable from zero to 10 volts RMS, distortion less than 0.1% to 100 kHz, Krohn-Hite Model 4300A or equivalent.

3. High impedance digital voltmeter (DVM), capable of measuring up to 350 volts with 1 volt resolution, Fluke Model 8000A or equivalent.

4. AC voltmeter (ACVM) capable of measuring up to 150 volts RMS, with 2% accuracy, Ballantine Model 314A with probe or equivalent.

5. Variable autotransformer (Variac), with 0-5A ammeter scale, for adjusting AC line voltage.

6. Test load, 200 ohm, 5%, 100W non-inductive resistor.

6.3 INITIAL SET-UP

1. Make the appropriate power connections as outlined in Section 2, Operation, Paragraph 2.1.

2. Connect the 7500 to the Variac.

3. Set the controls to the following positions (refer to Section 2, Operation and Figure 8, page 8):

GAIN	VARIABLE, Pot Max CCW
INPUT OFFSET	0, Pot Max CCW
INPUT COUPLING	DC
CHASSIS/FLOATING	CHASSIS

4. Set the 7500 POWER switch to ON and turn the Variac up slowly. Monitor the AC line current; it should not exceed 1.5 amperes (.75 amperes for 230V operation). Set the Variac for the correct line voltage.

5. Allow the instrument to warm up for at least 30 minutes.

6.4 REGULATED DC SUPPLY ADJUST

Connect the DVM to TP +240V. Adjust R107 for +240V, ±1V.
Connect the DVM to TP -240V. Adjust R121 for -240V, ±1V.

6.5 OUTPUT DC LEVEL ADJUST

Connect the DVM to the amplifier's OUTPUT terminals. Set the output DC level by means of the front panel ZERO ADJ screwdriver control. Tolerance: 0 ± 5 mv.

6.6 INPUT BROADBANDING

Connect the oscilloscope and the 200 ohm test load to the amplifier OUTPUT. Set the scope vertical gain to 20V/cm, cal., DC coupled. Set the amplifier GAIN control to x10. Connect the square wave output of the sine/square generator to the amplifier INPUT. Set the generator frequency to approximately 1 kHz. Adjust the generator's output voltage to obtain a 50V p-p square wave on the amplifier's OUTPUT. Adjust C202 for an optimum output square wave.

6.7 SQUARE WAVE RESPONSE

Change the generator frequency to 100 kHz, and turn its output voltage to zero. Set the amplifier GAIN control to x100. Adjust the generator's output voltage to obtain 100V p-p square wave on the amplifier OUTPUT. Adjust C221, R220 and R230 for an optimum output square wave.

6.8 OUTPUT LIMITING CIRCUIT ADJUST

Connect a 200 ohm load to the Amplifier output. Change the output of the generator to sinewave, frequency to 200 kHz. Connect the ACVM to the Amplifier output. Adjust the generator's output voltage to obtain 122.5V RMS on the Amplifier's output. Monitor the AC line current with the Variac; current should not exceed 3.5 amperes (1.75 amperes for 230V operation).

CAPACITORS (CONT.)

Symbol	Description			Mfr.	Part No.
C404	4uf		450V	SP	TVA-1702
C405	680pf	10%	500V	ELM	DM19C681K
C500	680pf	10%	500V	ELM	DM19C681K
C501	680pf	10%	500V	ELM	DM19C681K
C600	18pf	10%	500V	ELM	DM15C180K
C601	300pf	10%	500V	ELM	DM15C301K
C603	39pf	10%	500V	ELM	DM15C390K
C604	15pf	10%	500V	ELM	DM15C150K
C606	47pf	10%	500V	ELM	DM15C470K
C607	300pf	10%	500V	ELM	DM15C301K
C608	27pf	10%	500V	ELM	DM15C270K
C611	100pf	10%	500V	ELM	DM15C101K
C612	0.01uf	20%	500V	SP	C023B501G103M
C613	22pf	10%	500V	ELM	DM15C220K
C700	300pf	10%	500V	ELM	DM15C301K

Symbol	Description			Mfr.	Part No.
C701	300pf	10%	500V	ELM	DM15C301K
C702	22pf	10%	500V	ELM	DM15C220K
C704	100pf	10%	500V	ELM	DM15C101K
C705	390pf	10%	500V	ELM	DM15C391K
C706	390pf	10%	500V	ELM	DM15C391K
C707	47pf	10%	500V	ELM	DM15C470K
C708	390pf	10%	500V	ELM	DM15C391K
C709	390pf	10%	500V	ELM	DM15C391K
C710	39pf	10%	500V	ELM	DM15C390K
C711	390pf	10%	500V	ELM	DM15C391K
C712	18pf	10%	500V	ELM	DM15C180K
C801	10pf	10%	500V	ASP	9213-10110
C802	10pf	10%	500V	ASP	9213-10110
C900	0.068uf		400V	CD	WMF1D68
C901	0.068uf		400V	CD	WMF1D68
C902	0.01uf	20%	500V	SP	C023B501G103M
C903	0.01uf	20%	500V	SP	C023B501G103M

TRANSISTORS, DIODES & MISC.

Symbol	Description	Mfr.	Part No.
Q100	2N5657	MOT	2N5657
Q101	MPSU60	MOT	MPSU60
Q102	MPSU10	MOT	MPSU10
Q103	MPSU10	MOT	MPSU10
Q104	2N5657	MOT	2N5657
Q105	2N5657	MOT	2N5657
Q106	MPSU60	MOT	MPSU60
Q107	MPSU60	MOT	MPSU60
Q200	SU2366	TD	SU2366
Q201	MPS6566	MOT	MPS6566
Q202	2N4938	MOT	2N4938
Q203	2N5087	MOT	2N5087
Q220	2N5551	MOT	2N5551
Q221	2N5551	MOT	2N5551
Q222	MPS6566	MOT	MPS6566
Q223	2N5657	MOT	2N5657
Q250	MPS6515	MOT	MPS6515
Q251	MPSU60	MOT	MPSU60
Q252	MPS6515	MOT	MPS6515
Q270	MPS6518	MOT	MPS6518
Q271	MPS6566	MOT	MPS6566
Q300	MPS6515	MOT	MPS6515
Q301	MPS3640	MOT	MPS3640
Q302	MPS3640	MOT	MPS3640
Q303	2N5401	MOT	2N5401
Q304	2N5401	MOT	2N5401
Q305	2N5657	MOT	2N5657
Q306	2N5401	MOT	2N5401
Q307	2N5657	MOT	2N5657
Q308	2N5401	MOT	2N5401
Q309	2N5657	MOT	2N5657
Q310	2N5401	MOT	2N5401
Q311	2N5657	MOT	2N5657
Q400	2N5551	MOT	2N5551
Q401	2N5657	MOT	2N5657
Q402	2N5551	MOT	2N5551
Q403	2N5657	MOT	2N5657
Q404	2N5551	MOT	2N5551
Q405	2N5657	MOT	2N5657
Q406	2N5551	MOT	2N5551
Q407	2N5657	MOT	2N5657
Q408	MPS6518	MOT	MPS6518
Q409	MPS3646	MOT	MPS3646

Symbol	Description	Mfr.	Part No.
Q410	MPS3640	MOT	MPS3640
Q600	2N5551	MOT	2N5551
Q601	2N5657	MOT	2N5657
Q602	2N5657	MOT	2N5657
Q603	2N5657	MOT	2N5657
Q604	2N5657	MOT	2N5657
Q605	2N5551	MOT	2N5551
Q606	2N5657	MOT	2N5657
Q607	2N5657	MOT	2N5657
Q608	2N5657	MOT	2N5657
Q609	2N5657	MOT	2N5657
Q610	2N5551	MOT	2N5551
Q611	2N5657	MOT	2N5657
Q612	2N5657	MOT	2N5657
Q613	2N5657	MOT	2N5657
Q614	2N5657	MOT	2N5657
Q615	2N5657	MOT	2N5657
Q616	2N5657	MOT	2N5657
Q617	2N5657	MOT	2N5657
Q618	2N5657	MOT	2N5657
Q619	2N5657	MOT	2N5657
Q700	2N5415	RCA	2N5415
Q701	2N5657	MOT	2N5657
Q702	2N5657	MOT	2N5657
Q703	2N5657	MOT	2N5657
Q704	2N5657	MOT	2N5657
Q705	2N5401	MOT	2N5401
Q706	2N5657	MOT	2N5657
Q707	2N5657	MOT	2N5657
Q708	2N5657	MOT	2N5657
Q709	2N5657	MOT	2N5657
Q710	2N5401	MOT	2N5401
Q712	2N5657	MOT	2N5657
Q713	2N5657	MOT	2N5657
Q714	2N5657	MOT	2N5657
Q715	2N5401	MOT	2N5401
Q716	2N5657	MOT	2N5657
Q717	2N5657	MOT	2N5657
Q718	2N5657	MOT	2N5657
Q719	2N5657	MOT	2N5657
Q800	MPS3646	MOT	MPS3646
Q801	2N5087	MOT	2N5087
Q900	MPS6518	MOT	MPS6518
Q901	MPS6515	MOT	MPS6515
Q902	MPS6566	MOT	MPS6566
Q903	MPS6518	MOT	MPS6518

TRANSISTORS, DIODES & MISC.(CONT.)

Symbol	Description	Mfr.	Part No.
CR100	1N5627	MOT	1N5627
CR101	1N5627	MOT	1N5627
CR102	1N5627	MOT	1N5627
CR103	1N5627	MOT	1N5627
CR104	1N4004	ITT	1N4004
CR105	1N4004	ITT	1N4004
CR106	MZ2361	MOT	MZ2361
CR107	1N4149	APD	1N4149
CR108	1N4004	ITT	1N4004
CR109	1N4004	ITT	1N4004
CR110	1N4004	ITT	1N4004
CR111	1N4004	ITT	1N4004
CR112	MZ2361	MOT	MZ2361
CR113	1N967B	APD	1N967B
CR114	1N4004	ITT	1N4004
CR115	1N4004	ITT	1N4004
CR116	MZ2361	MOT	MZ2361
CR117	1N4149	APD	1N4149
CR118	1N4149	APD	1N4149
CR119	1N4004	ITT	1N4004
CR120	1N4004	ITT	1N4004
CR121	1N4004	ITT	1N4004
CR122	1N4004	ITT	1N4004
CR123	1N4004	ITT	1N4004
CR124	1N4004	ITT	1N4004
CR125	1N967B	APD	1N967B
CR126	MZ2361	MOT	MZ2361
CR200	1N976B	APD	1N976B
CR201	1N971B	APD	1N971B
CR210	1N976B	APD	1N976B
CR250	1N749A	APD	1N749A
CR251	1N4149	APD	1N4149
CR252	1N4149	APD	1N4149
CR253	1N4149	APD	1N4149
CR254	1N4149	APD	1N4149
CR269	1N4149	APD	1N4149
CR270	1N4149	APD	1N4149
CR271	1N4149	APD	1N4149
CR272	FD300	FR	FD300
CR273	FD300	FR	FD300
CR274	1N4149	APD	1N4149
CR275	1N4149	APD	1N4149
CR276	1N4149	APD	1N4149
CR300	1N4002	AS	1N4002
CR301	1N4002	AS	1N4002
CR302	1N4002	AS	1N4002
CR303	1N4002	AS	1N4002
CR500	1N4936	MOT	1N4936
CR501	1N4936	MOT	1N4936
CR600	1N4149	APD	1N4149
CR601	1N4149	APD	1N4149
CR602	1N4933	MOT	1N4933
CR603	1N4149	APD	1N4149
CR700	1N4149	APD	1N4149
CR701	1N4149	APD	1N4149
CR800	1N4933	MOT	1N4933
CR801	1N4933	MOT	1N4933
CR802	1N4933	MOT	1N4933
CR803	1N4933	MOT	1N4933
CR900	1N4933	MOT	1N4933
CR901	1N4933	MOT	1N4933
L200	220 uhy	DLV	3500-16
L300	3.3 uhy	DLV	1537-24
L400	3.3 uhy	DLV	1537-24
L700	3.3 uhy	DLV	1537-24
L800	BEAD FERRITE, 25 uhy	CB	6470-7
F101	FUSE,SLOW BLOW,115V	BUS	MDL-5A
	FUSE,SLOW BLOW,230V	BUS	MDL-2.5A
F901	FUSE,FAST BLOW,1A	BUS	MDX-1A
F902	FUSE,FAST BLOW,1A	BUS	MDX-1A
I101	LAMP,INDICATOR,POWER	ELD	EG03-CCB-N110
I201	LAMP,INDICATOR,OVERLOAD	ELD	EG03-CCB-N110
J101	RECEPTACLE,POWER	SWC	EAC-301
S101	SWITCH,TOGGLE,POWER		7561KA
S102	SWITCH,SLIDE,GROUND	CW	GF1123
S201, S202, S240	SWITCH,PUSHBUTTON,ASS'Y	KH	B3135
T101	TRANSFORMER,POWER	KH	B3562
	LINECORD	PI	13E37-1

MANUFACTURERS CODE

AB	(01121)	Allen Bradley Co.	Milwaukee, Wisc.
APD	(50273)	American Power Devices	Andover, Mass.
AS	( )	Atlantic Semiconductor	Woodland Hills, Calif.
ASP	(82142)	Airco Speer	Dubois, Pa.
BKM	(30646)	Beckman Instr. Co.	Milwaukee, Wisc.
BUS	(71400)	Bussman Mfg. Div.	St. Louis, Mo.
CB	( )	Caddell Burns Mfg.	Mineola, N.Y.
CD	(88419)	Cornell Dubilier	Norwood, Mass.
CW	(79727)	C-W Industries	Warminster, Pa.
DLV	(99800)	Delevan Electronics	East Aurora, N.Y.
ELD	(03797)	Eldema Corp.	Compton, Calif.
ELM	(72136)	Electromotive Mfg.	Willimantic, Conn.
ERT	(72982)	Erie Technological	Erie, Pa.
IRC	(12400)	International Resistor Corp.	Philadelphia, Pa.
ITT	( )	ITT Semiconductor	Woburn, Mass.
KH	(88865)	Krohn-Hite Corp.	Avon, Mass.
KID	(12126)	Kidco, Inc.	Medford, N.J.
MAL	(37942)	P. R. Mallory & Co.	Indianapolis, Ind.
MOT	(04713)	Motorola Semiconductor	Phoenix, Az.
PI	( )	Phillips Industries	Chicago, Ill.
RCA	(49671)	Radio Corp. of America	Harrison, N.J.
SP	(56289)	Sprague Electric Co.	North Adams, Mass.
STT	( )	Stettner-Trush	Cazanovia, N.Y.
SWC	(82389)	Switchcraft, Inc.	Chicago, Ill.
TD	( )	Teledyne Semiconductor	Mountain View, Calif.
WEL	( )	Welwyn, International	Wesllake, Ohio

RESISTORS (CONT.)

Symbol	Description			Mfr.	Part No.
R631	100	10%	1/4W	AB	CB1011
R632	8.2K	5%	4W	WEL	F32
R633	56K	10%	1/4W	AB	CB5631
R634	1K	10%	1/4W	AB	CB1021
R635	39K	10%	1/4W	AB	CB3931
R637	200	5%	1/4W	AB	CB2015
R638	330	10%	1/4W	AB	CB3311
R639	1	10%	1/2W	AB	EB10G1
R640	15	10%	1/2W	AB	EB1501
R641	1	10%	1/2W	AB	EB10G1
R642	9.1	5%	1W	AB	GB91G5
R643	1	10%	1/2W	AB	EB10G1
R644	27	10%	1/4W	AB	CB2701
R645	6.8	10%	1W	AB	GB68G1
R646	1	10%	1/2W	AB	EB10G1
R647	4.7	10%	1/2W	AB	EB47G1
R649	100	10%	1/4W	AB	CB1011
R651	27	10%	1/4W	AB	CB2701
R652	24	5%	1/4W	AB	CB2405
R653	27	10%	1/4W	AB	CB2701
R654	47	10%	1/2W	AB	EB47G1
R655	27	10%	1/4W	AB	CB2701
R656	4.7	10%	1/2W	AB	EB47G1
R657	27	10%	1/4W	AB	CB2701
R658	4.7	10%	1/2W	AB	EB47G1
R659	4.7	10%	1/2W	AB	EB47G1
R660	22K	10%	2W	AB	HB2231
R661	22K	10%	2W	AB	HB2231
R700	39	10%	1/4W	AB	CB3901
R702	51	5%	1/2W	AB	EB5105
R703	1K	10%	1/4W	AB	CB1021
R704	8.2K	5%	4W	WEL	F32
R705	56K	10%	1/4W	AB	CB5631
R706	24	5%	1/4W	AB	CB2405
R707	4.7	10%	1/2W	AB	EB47G1
R708	4.7	10%	1/2W	AB	EB47G1
R709	4.7	10%	1/2W	AB	EB47G1
R710	4.7	10%	1/2W	AB	EB47G1
R711	22K	10%	2W	AB	HB2231
R712	22K	10%	2W	AB	HB2231
R713	100	10%	1/4W	AB	CB1011
R714	8.2K	5%	4W	WEL	F32
R715	200	5%	1/4W	AB	CB2015
R716	39	10%	1/4W	AB	CB3901
R717	1	10%	1/2W	AB	EB10G1
R718	15	10%	1/2W	AB	EB1501
R719	1	10%	1/2W	AB	EB10G1
R720	9.1	5%	1W	AB	GB91G5
R721	10	10%	2W	AB	HB1001
R722	1	10%	1/2W	AB	EB10G1

Symbol	Description			Mfr.	Part No.
R723	6.8	10%	1W	AB	GB68G1
R724	1	10%	1/2W	AB	EB10G1
R725	4.7	10%	1/2W	AB	EB47G1
R726	47	10%	1/4W	AB	CB4701
R727	100	10%	1/4W	AB	CB1011
R728	8.2K	5%	4W	WEL	F32
R729	200	5%	1/4W	AB	CB2015
R730	39	10%	1/4W	AB	CB3901
R731	1	10%	1/2W	AB	EB10G1
R732	15	10%	1/2W	AB	EB1501
R733	1	10%	1/2W	AB	EB10G1
R734	9.1	5%	1W	AB	GB91G5
R735	10	10%	2W	AB	HB1001
R736	1	10%	1/2W	AB	EB10G1
R737	6.8	10%	1W	AB	GB68G1
R738	1	10%	1/2W	AB	EB10G1
R739	4.7	10%	1/2W	AB	EB47G1
R740	47	10%	1/4W	AB	CB4701
R741	100	10%	1/4W	AB	CB1011
R742	8.2K	5%	4W	WEL	F32
R743	200	5%	1/4W	AB	CB2015
R744	39	10%	1/4W	AB	CB3901
R745	1	10%	1/2W	AB	EB10G1
R746	15	10%	1/2W	AB	EB1501
R747	1	10%	1/2W	AB	EB10G1
R748	9.1	5%	1W	AB	GB91G5
R749	10	10%	2W	AB	HB1001
R750	1	10%	1/2W	AB	EB10G1
R751	6.8	10%	1W	AB	GB68G1
R752	1	10%	1/2W	AB	EB10G1
R753	4.7	10%	1/2W	AB	EB47G1
R800	2.2	10%	1/2W	AB	EB22G1
R801	2.2	10%	1/2W	AB	EB22G1
R802	2.2	10%	1/2W	AB	EB22G1
R803	2.2	10%	1/2W	AB	EB22G1
R804	2.2	10%	1/2W	AB	EB22G1
R805	2.2	10%	1/2W	AB	EB22G1
R806	2.2	10%	1/2W	AB	EB22G1
R807	2.2	10%	1/2W	AB	EB22G1
R808	12	5%	1W	AB	GB1205
R809	12	5%	1W	AB	GB1205
R810	12	5%	1W	AB	GB1205
R811	10	10%	1/4W	AB	CB1001
R812	10	10%	1/4W	AB	CB1001
R813	10	10%	1/4W	AB	CB1001
R900	1.5K	10%	1/4W	AB	CB1521
R901	1.5K	10%	1/4W	AB	CB1521
R902	3.3K	10%	1/4W	AB	CB3321
R903	39	10%	1/4W	AB	CB3901
R904	39	10%	1/4W	AB	CB3901
R905	3.3K	10%	1/4W	AB	CB3321

CAPACITORS

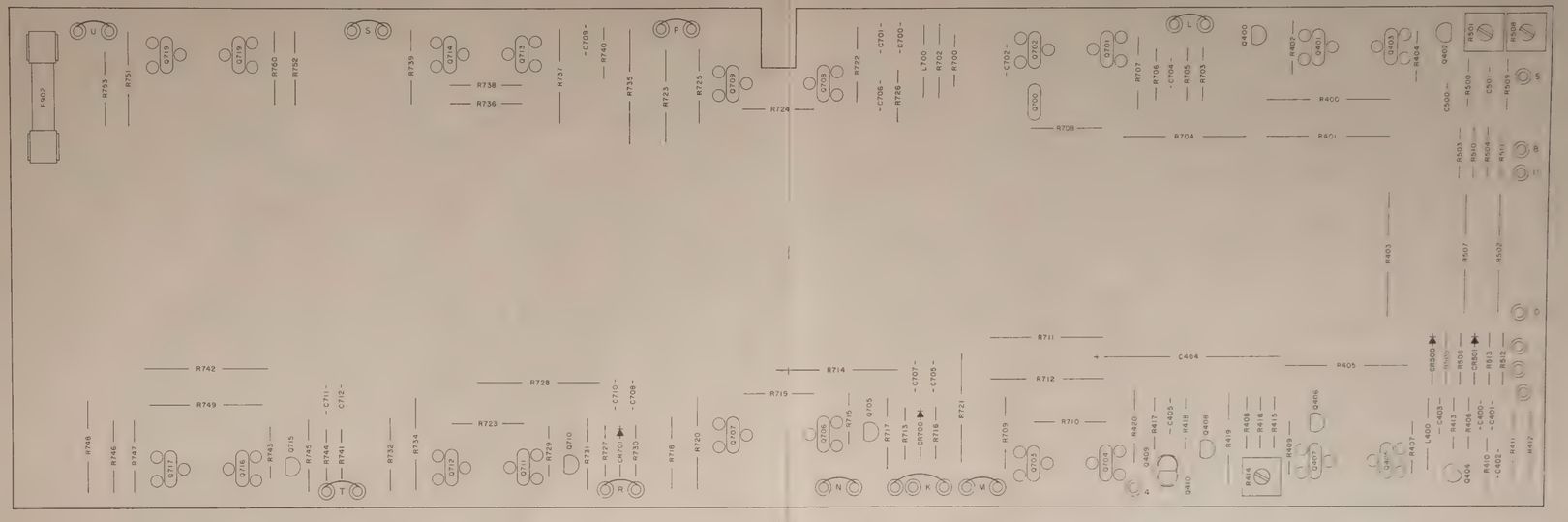
Symbol	Description			Mfr.	Part No.
C100	.002uf	20%	500V	SP	C023B102F202M
C101	.002uf	20%	500V	SP	C023B102F202M
C102	.002uf	20%	500V	SP	C023B102F202M
C103	.002uf	20%	500V	SP	C023B102F202M
C104	880uf		350V	SP	36DX881F350BC2A
C105	880uf		350V	SP	36DX881F350BC2A
C106	4uf		450V	SP	TVA-1702
C107	.47uf	20%	100V	ERT	8131-100-651-474M
C108	20uf		450V	SP	TVA-1709
C109	4uf		450V	SP	TVA-1702
C110	.47uf	20%	100V	ERT	8131-100-651-474M
C111	20uf		450V	SP	TVA-1709
C112	0.02uf	20%	1000V	SP	C023B102M203M
C200	0.22uf	10%	400V	CD	WMF4P22
C201	10pf	10%	500V	ASP	9213-10110
C202	4.5-20pf TRIMMER			STT	75-TRIKO-02-4.5 /20pf
C203	10pf	10%	500V	ASP	9213-10110
C204	1uf		50V	SP	30D150G050BA4
C205	1uf		50V	SP	30D150G050BA4
C206	27pf	10%	500V	ELM	DM15C270K
C207	1.5pf	10%	500V	ASP	9207-15910
C220	390pf	10%	500V	ELM	DM15C391K
C221	0.8-4.5pf TRIMMER			ERT	561-031
C222	0.1uf	20%	100V	ERT	8131-100-651-104M
C223	150pf	10%	500V	ELM	DM15C151K

Symbol	Description			Mfr.	Part No.
C224	1uf		50V	SP	30D150G050BA4
C225	1000pf	20%	500V	SP	C023B501E102M
C240	0.1uf	20%	500V	SP	C023A501Y104M
C241	0.1uf	20%	500V	SP	C023A501Y104M
C250	0.1uf	10%	400V	CD	WMF4P10
C260	0.1uf	20%	500V	SP	C023A501Y104M
C261	0.1uf	20%	500V	SP	C023A501Y104M
C270	1000pf	20%	500V	SP	C023B501E102M
C300	680pf	10%	500V	ELM	DM15C681K
C301	4uf		450V	SP	TVA-1702
C302	470pf	10%	500V	ELM	DM19C471K
C303	0.1uf	20%	100V	ERT	8131-100-651-104M
C304	0.01uf	20%	500V	SP	C023B501G103M
C305	0.0047uf	20%	500V	SP	C023B501F472M
C306	1uf	20%	35V	MAL	TDC105M035AL
C307	0.02uf	20%	1000V	SP	C023B102M203M
C308	0.02uf	20%	1000V	SP	C023B102M203M
C400	0.01uf	20%	500V	SP	C023B501G103M
C401	0.0047uf	20%	500V	SP	C023B501F472M
C402	0.1uf	20%	100V	ERT	8131-100-651-104M
C403	470pf	10%	500V	ELM	DM19C471K

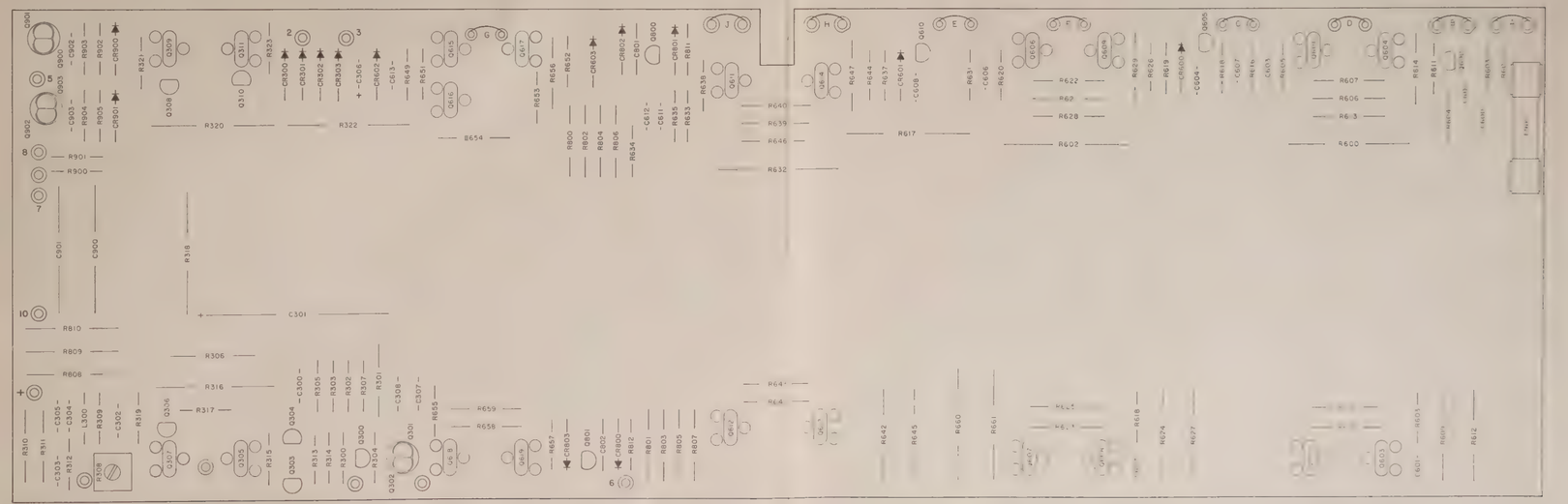
RESISTORS

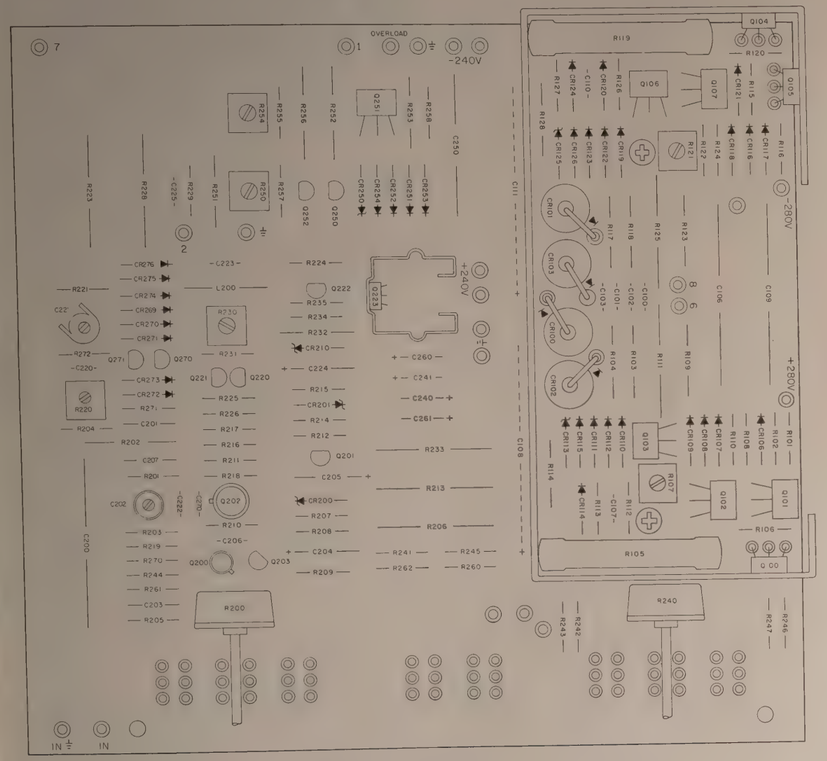
Symbol	Description			Mfr.	Part No.
R100	100K	10%	1/4W	AB	CB1041
R101	2.7	10%	1/4W	AB	CB27G1
R102	22K	10%	1/4W	AB	CB2231
R103	82K	10%	1/2W	AB	EB8231
R104	62K	5%	1/2W	AB	EB6235
R105	1.5K		12W	IRC	B7434
R106	1K	10%	1/4W	AB	CB1021
R107	25K POT			BKM	72PM
R108	15K	10%	1/4W	AB	CB1531
R109	220K	10%	1/2W	AB	EB2241
R110	100	10%	1/4W	AB	CB1011
R111	100K	10%	2W	AB	HB1041
R112	100	10%	1/4W	AB	CB1011
R113	10K	10%	1/4W	AB	CB1031
R114	220K	10%	1/2W	AB	EB2241
R115	2.7	10%	1/4W	AB	CB27G1
R116	22K	10%	1/4W	AB	CB2231
R117	82K	10%	1/2W	AB	EB8231
R118	62K	5%	1/2W	AB	EB6235
R119	1.5K		12W	IRC	B7434
R120	1K	10%	1/4W	AB	CB1021
R121	25k POT			BKM	72PM
R122	15K	10%	1/4W	AB	CB1531
R123	220K	10%	1/2W	AB	EB2241
R124	100	10%	1/4W	AB	CB1011
R125	100K	10%	2W	AB	HB1041
R126	100	10%	1/4W	AB	CB1011
R127	10K	10%	1/4W	AB	CB1031
R128	220K	10%	1/2W	AB	EB2241
R129	4.7	10%	1/4W	AB	CB47G1
R200	5K POT			KH	A3136-1-A
R201	10M	10%	1/4W	AB	CB1061
R202	1M	0.1%	1/2W	KID	M5-T1-1M
R203	111K	0.5%	1/8W	KID	M3-T1-111K
R204	100K	10%	1/4W	AB	CB1041
R205	5.6K	10%	1/4W	AB	CB5621
R206	27K	10%	2W	AB	HB2731
R207	7.5K	5%	1/4W	AB	CB7525
R208	15K	10%	1/4W	AB	CB1531
R209	5.6K	10%	1/4W	AB	CB5621
R210	2K	5%	1/4W	AB	CB2025
R211	2K	5%	1/4W	AB	CB2025
R212	12K	10%	1/4W	AB	CB1231
R213	47K	10%	2W	AB	HB4731
R214	10K	10%	1/4W	AB	CB1031
R215	18K	10%	1/4W	AB	CB1831
R216	12.4K	1%	1/4W	AB	CC1242F
R217	12.4K	1%	1/4W	AB	CC1242F
R218	10K	10%	1/4W	AB	CB1031
R219	51K	5%	1/4W	AB	CB5135
R220	5K POT			BKM	72PM
R221	1.005K	0.1%	1/8W	KID	M3-T1-1.005K
R223	100K	0.5%	1W	KID	M6-T1-100K
R224	100	10%	1/4W	AB	CB1011
R225	100	10%	1/4W	AB	CB1011
R226	1.005K	0.1%	1/8W	KID	M3-T1-1.005K
R228	100K	0.5%	1W	KID	M6-T1-100K
R229	1M	5%	1/4W	AB	CB1055
R230	100 POT			BKM	72PM
R231	220	10%	1/4W	AB	CB2211
R232	750	5%	1/2W	AB	EB7515
R233	16K	5%	4W	WEL	F32
R234	10K	10%	1/4W	AB	CB1031
R235	33K	10%	1/4W	AB	CB3331
R240	250K POT			KH	A3136-2-A
R241	12K	10%	1/4W	AB	CB1231
R242	240K	5%	1/4W	AB	CB2445
R243	240K	5%	1/4W	AB	CB2445
R244	100K	10%	1/4W	AB	CB1041
R245	12K	10%	1/4W	AB	CB1231
R246	240K	5%	1/4W	AB	CB2445
R247	240K	5%	1/4W	AB	CB2445
R250	100K POT			BKM	72PM
R251	470K	10%	1/2W	AB	EB4741
R252	100K	10%	1W	AB	GB1041
R253	180K	5%	1/2W	AB	EB1845
R254	1M POT			BKM	72PM
R255	100K	10%	1/4W	AB	CB1041
R256	100K	10%	1W	AB	GB1041
R257	100K	10%	1/4W	AB	CB1041
R258	680K	10%	1/4W	AB	CB6841
R260	820K	10%	1/4W	AB	CB8241
R261	6.8M	5%	1/4W	AB	CB6855
R262	820K	10%	1/4W	AB	CB8241
R263	2.5M POT			AB	70A8N025S25SMA
R270	47K	10%	1/4W	AB	CB4731
R271	27K	10%	1/4W	AB	CB2731

Symbol	Description			Mfr.	Part No
R300	1K	10%	1/4W	AB	CB1021
R301	220K	10%	1/2W	AB	EB2241
R302	47	10%	1/4W	AB	CB4701
R303	1K	10%	1/4W	AB	CB1021
R304	100	10%	1/4W	AB	CB1011
R305	680	10%	1/4W	AB	CB6841
R306	100K	10%	1W	AB	GB1041
R307	1K	10%	1/4W	AB	CB1021
R308	200 POT			BKM	72PM
R309	24	5%	1/4W	AB	CB2405
R310	27	10%	1/2W	AB	EB2701
R311	51	5%	1/2W	AB	EB5105
R312	4.7	10%	1/4W	AB	CB47G1
R313	150	10%	1/4W	AB	CB1511
R314	100	10%	1/4W	AB	CB1011
R315	150	10%	1/4W	AB	CB1511
R316	8.2K	5%	4W	WEL	F32
R317	300K	5%	1/4W	AB	CB3045
R318	8.2K	5%	4W	WEL	F32
R319	150	10%	1/4W	AB	CB1511
R320	8.2K	5%	4W	WEL	F32
R321	150	10%	1/4W	AB	CB1511
R322	8.2K	5%	4W	WEL	F32
R323	150	10%	1/4W	AB	CB1511
R400	8.2K	5%	4W	WEL	F32
R401	8.2K	5%	4W	WEL	F32
R402	150	10%	1/4W	AB	CB1511
R403	8.2K	5%	4W	WEL	F32
R404	150	10%	1/4W	AB	CB1511
R405	8.2K	5%	4W	WEL	F32
R406	270K	10%	1/4W	AB	CB2741
R407	150	10%	1/4W	AB	CB1511
R408	100	10%	1/4W	AB	CB1011
R409	150	10%	1/4W	AB	CB1511
R410	24	5%	1/4W	AB	CB2405
R411	51	5%	1/2W	AB	EB5105
R412	27	10%	1/2W	AB	EB2701
R413	24	5%	1/4W	AB	CB2405
R414	200 POT			BKM	72PM
R415	1K	10%	1/4W	AB	CB1021
R416	1.8K	10%	1/4W	AB	CB1821
R417	100	10%	1/4W	AB	CB1011
R418	1K	10%	1/4W	AB	CB1021
R419	100K	10%	1W	AB	GB1041
R420	220K	10%	1/2W	AB	EB2241
R500	360K	5%	1/4W	AB	CB3645
R501	1M POT			BKM	72PM
R502	470K	10%	2W	AB	HB4741
R503	390K	10%	1/4W	AB	CB3941
R504	3.9K	10%	1/4W	AB	CB3921
R505	680K	5%	1/4W	AB	CB6845
R506	680K	5%	1/4W	AB	CB6845
R507	470K	10%	2W	AB	HB4741
R508	1M POT			BKM	72PM
R509	360K	5%	1/4W	AB	CB3645
R510	390K	10%	1/4W	AB	CB3941
R511	3.9K	10%	1/4W	AB	CB3921
R512	680K	5%	1/4W	AB	CB6845
R513	680K	5%	1/4W	AB	CB6845
R600	8.2K	5%	4W	WEL	F32
R601	100	10%	1/4W	AB	CB1011
R602	8.2K	5%	4W	WEL	F32
R603	39	10%	1/4W	AB	CB3901
R604	200	5%	1/4W	AB	2015
R605	330	10%	1/4W	AB	CB3311
R606	1	10%	1/2W	AB	EB10G1
R607	15	10%	1/2W	AB	EB1501
R608	1	10%	1/2W	AB	EB10G1
R609	9.1	5%	1W	AB	GB9155
R610	1	10%	1/2W	AB	EB10G1
R611	27	10%	1/4W	AB	CB2701
R612	6.8	10%	1W	AB	GB6861
R613	1	10%	1/2W	AB	EB10G1
R614	4.7	10%	1/2W	AB	EB47G1
R616	100	10%	1/4W	AB	CB1011
R617	8.2K	5%	4W	WEL	F32
R618	39	10%	1/4W	AB	CB3901
R619	200	5%	1/4W	AB	CB2015
R620	330	10%	1/4W	AB	CB3311
R621	1	10%	1/2W	AB	EB10G1
R622	15	10%	1/2W	AB	EB1501
R623	1	10%	1/2W	AB	EB10G1
R624	9.1	5%	1W	AB	GB9155
R625	1	10%	1/2W	AB	EB10G1
R626	27	10%	1/4W	AB	CB2701
R627	6.8	10%	1W	AB	GB6861
R628	1	10%	1/2W	AB	EB10G1
R629	4.7	10%	1/2W	AB	EB47G1



PC 751





PC 753

NOTES:
ALL RESISTORS IN OHMS UNLESS OTHERWISE SPECIFIED.
FOR WATTAGE AND TOLERANCES, SEE PARTS LIST.
S201 SHOWN IN ±100 POSITION.
S202 SHOWN IN DC POSITION.
FRONT PANEL CONTROL
REAR PANEL CONTROL
PC CARD CONTROL
MAIN FEEDBACK PATH
SIGNAL PATH
VOLTAGE DATA WITH UNREG. ADJUSTED TO ±300V.

Set R308, R414, R501 and R508 to their maximum counterclockwise positions. Observe the Amplifier's output signal on the scope. Adjust R308 until the positive peak of the sinewave begins to distort, then back off slightly. Adjust R414 in a similiar manner for the negative peak.

Set the generator for 20 Hz. Adjust the generator's output voltage to obtain 130V RMS on the Amplifier's output. Observe the Amplifier's output signal on the scope. Adjust R501 clockwise until the positive peak of the sinewave begins to distort, then back off slightly. Adjust R508 clockwise until the negative peak of the sinewave begins to distort, then back off slightly.

6.9 OUTPUT OVERLOAD INDICATOR ADJUSTMENT

Connect 200 ohm test load to amplifier output and scope to TP 1. Set oscillator frequency to 1 kHz. Increase oscillator output voltage until signal at TP 1 starts clipping.

Set R254 max counterclockwise. Turn R250 and observe that the OVERLOAD light goes on at ends of range and goes out in the middle. Set R250 to the center of this dark range. Now adjust R254 clockwise until the OVERLOAD light comes on again.

Repeat adjustment of R250, then R254 and so on until both pots are set so that light is just visible and gets brighter when R250 is moved either way.

MODIFICATION SHEET

MODEL NO. 7500	SCHEMATIC DATE 8/30/79	DATE 8/30/79

- PARTS LIST CORRECTIONS -

Schematic Reference	Change
R244	From 100K, 10%, 1/4W to 91K, 5%, 1/4W, AB p/n CB9135.
R272(Addition)	18K, 1/4W, 10%, p/n CB1831.
C707	From 47pf, 10%, 500V to 100pf, 10%, 500V, p/n DM15C101K.
Q700	From Motorola type 2N5415 to Motorola type MPSU60.

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Telephone 617/580-1660 — TWX 710-345-0831

SUPPLEMENT

OPERATING AND MAINTENANCE

MANUAL

KROHN-HITE CORPORATION

WIDEBAND AMPLIFIER MODEL 7500 /RK519

Instrument Ser No 600

TABLE OF CONTENTS

Para	Title	Page
1	Scope	1
2	Safety Precautions	2
3	Performance Specifications	2
4	Use of Test Points for Servicing	3
5	Test Equipment	3
6	Errata	3

1. SCOPE This supplement applies to a modified version of Krohn-Hite Wideband Amplifier Model 7500. Modifications are summarized below.

a Safety Modifications Safety modifications include hazard warnings printed conspicuously onto the power transformer and in this manual supplement.

b Performance Specifications In addition to commercial specifications published by the Krohn-Hite Corporation, the specifications of Army drawing 7915950 apply. These are listed in paragraph 3 of this supplement.

c Maintainability Modifications Additional test points have been added and co-ordinated with test voltages shown on the equipment schematic furnished in the Appendix of the manufacturer's manual. These test points and their function are described in paragraph 4 of this supplement.

d Errata Correction Miscellaneous corrections of manual errata are furnished in paragraph 6 of this supplement.

e Rack Slides Slides for mounting the instrument in a standard 19 inch EIA rack are furnished with the instrument.

f Part Number The modified instrument, together with the Krohn-Hite instruction manual and this supplement, is identified by Army Part No 7915950.

2. SAFETY PRECAUTIONS This instrument is capable of producing a 200 Volt peak output signal. Consequently, high voltages are presen at the output terminals and also on internal components. The following safety precautions should therefore be observed when operatin and servicing this instrument.

OUTPUT TERMINALS

Be sure not to come in contact with the output terminals during operation of the instrument.

INTERNAL COMPONENTS

Many of the internal components (e.g. board mounted fuses) have high voltages on their leads when the instrument is in operation. If it is necessary to come in contact with these components, be sure to disconnect the primary power cord and allow sufficient time (approx. 15 seconds) for the power supply filter capacitors to discharge.

3. PERFORMANCE SPECIFICATIONS The following performance specifications apply:

INPUT IMPEDANCE:	Single ended (at 1 kHz): 10^6 ohms shunt by 85 picofarad of less capacitance.
VOLTAGE GAIN:	20
VOLTAGE INPUT, MAXIMUM:	7.5 V RMS AC coupled, ±15 V DC coupling.
COUPLING:	AC or DC, selectable by front panel swit
OUTPUT PURITY:	Less than ±0.02% distortion at 1 kHz gra ally increasing to less than .1% at 10 K and 1% at 1 MHz.
OUTPUT VOLTAGE:	150 V RMS open circuit, 125 V RMS with matched load.
OUTPUT POWER:	25 VA RMS from 10 Hz to 500 KHz with matched load (400 ohms to 625 ohms).
GAIN STABILITY:	Short term ±0.001% long term ±0.01%.
REGULATION:	Less than ±0.01% output variation for a 10% line voltage change.
FREQUENCY RANGE:	10 Hz to 1 mHz, AC or DC coupled.
OVERLOAD PROTECTION:	Output shall be protected so that continu ous short will not cause damage to the amplifier. Protection shall be automatic with a front panel reset switch if reset is necessary.

POWER REQUIREMENTS: 115 VAC 50 to 400 Hz, single phase, less than 150 watts at full load output.

DIMENSIONS: 133 mm high x 430 mm deep x 305 mm wide.

MOUNTING: The amplifier shall be constructed to mount in a universal spaced standard 19-inch (483 mm) wide rack in accordance with EIA Standard RS 310 (May 1965).

WEIGHT: Weight shall be less than 16 kilograms, Max.

4. USE OF TEST POINTS FOR SERVICING The D.C. voltages listed on the schematic diagram (S 3554 Rev A) in the rear of the manual are important check points for troubleshooting purposes. However, care must be exercised in connecting test equipment in order to avoid shorting to adjacent circuits and damaging the instrument. Modifications have been made to make certain test points more accessible. Figure A-1 in this supplement shows the physical location of these selected test points. Figure A-2 is a reproduction of a portion of the instrument schematic which assigns "TP" designations to the selected test points and is to be used in conjunction with Figure A-1.

5. TEST EQUIPMENT The following indentification is provided for the test equipment described but not otherwise identified in Paragraph 3.2.

Digital Voltmeter: (DC Measurements and AC Measurements below 100 KHz) Hewlett Packard 3490A. For AC measurements above 100 KHz, use H.P. 400E A.C. Voltmeter.

Resistive Load: Test Load, Carborundum SP887 (200).

6. ERRATA

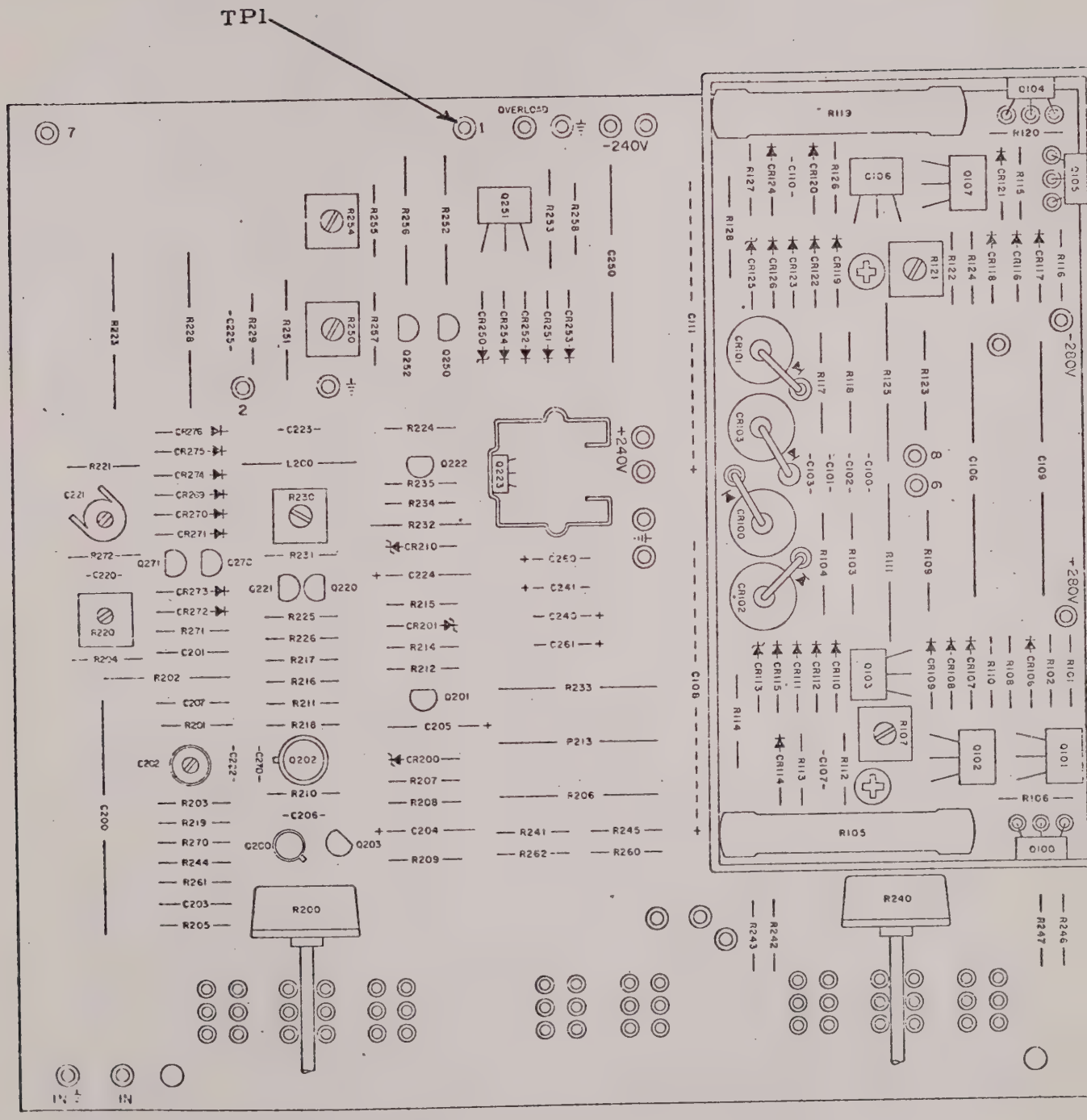
a Para 6.3 Interchange steps 4 and 5.

b Para 6.9 Add to end of paragraph:

"Reset oscillator frequency to 1 MHz and set output voltage to 45 volts R.M.S. The overload light should not be illuminated. Slowly increase the voltage to 48 volts. At this voltage, it is permissible for the OVERLOAD light to begin to illuminate. If the OVERLOAD light illuminates at 45 volts or less, re-adjust R254 slightly to achieve the above results.

c Schematic Changes: R808, R809, R810 changed from 12Ω, 1W, 5% Carbon AB P/N;GB1205 to 12Ω, 2W, 5% Wirewound Ohmite P/N 22J12R.

Add L740, .47μH, Delevan P/N 1537-06, in series with R740 and test point "P".



PC 753

FIG A-1 SHT 1

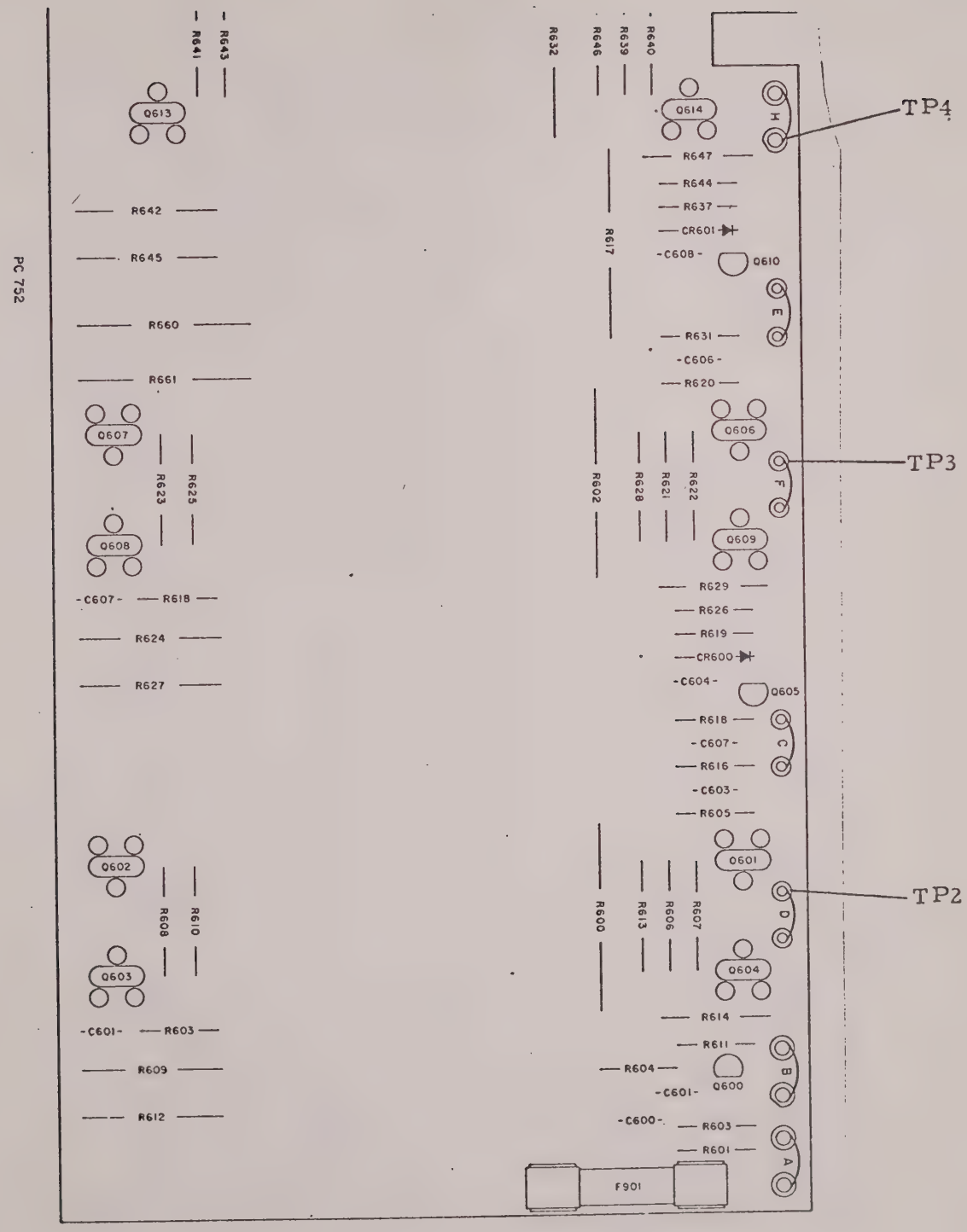

PC 752
R641
R643
Q613
R642
R645
R660
R661
Q607
R623
R625
Q608
-C607-
R618
R624
R627
Q602
R608
R610
Q603
-C601-
R603
R609
R612
R632
R646
R639
R640
Q614
H
TP4
R647
R644
R637
CR601
-C608-
Q610
E
R631
-C606-
R620
R617
Q606
TP3
F
R602
R628
R621
R622
Q609
R629
R626
R619
CR600
-C604-
Q605
R618
-C607-
C
R616
-C603-
R605
Q601
TP2
D
R600
R613
R606
R607
Q604
R614
R611
R604
Q600
B
-C601-
-C600-
R603
R601
A
F901

FIG A-1 SHT. 2

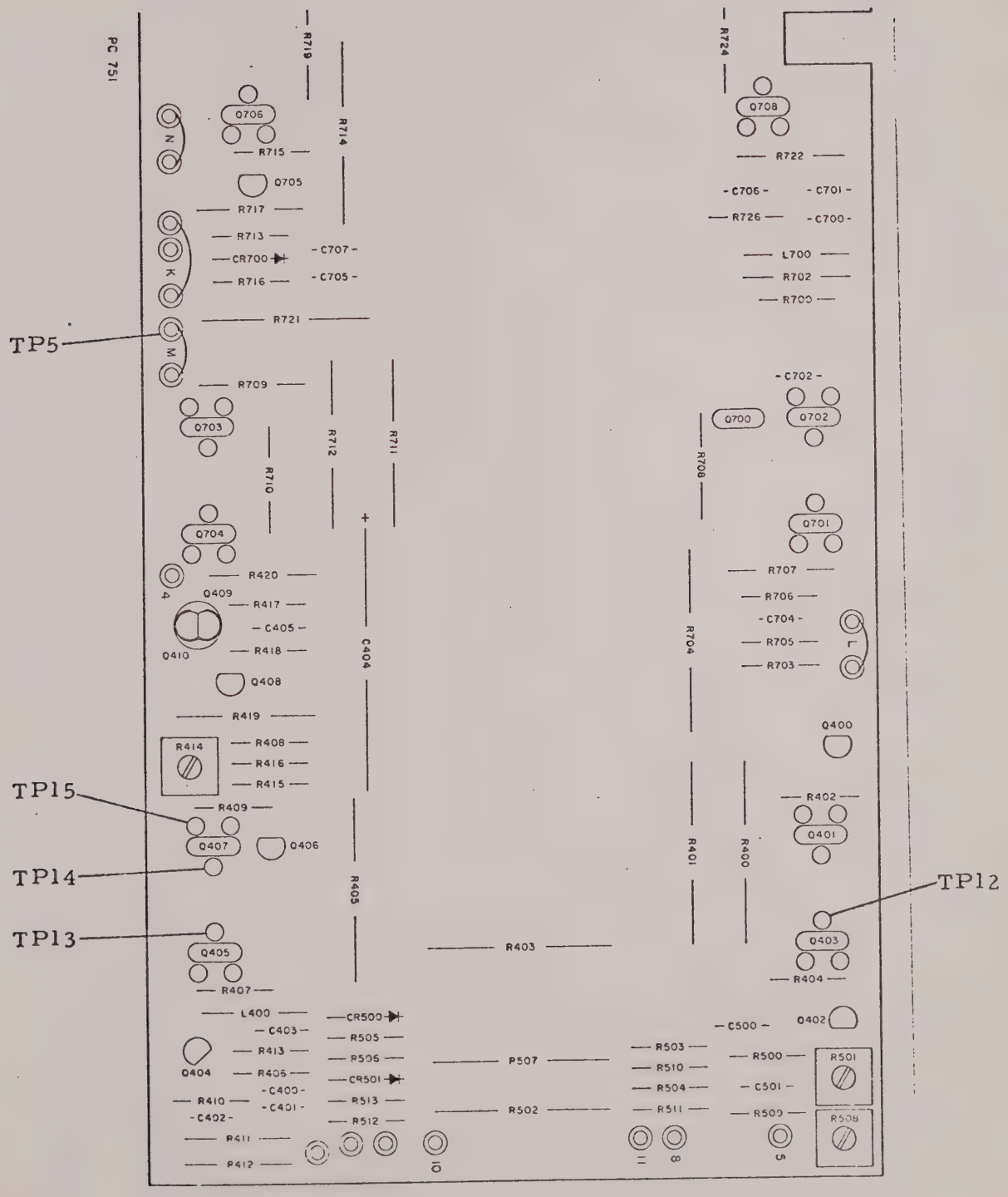

PC 751
TP5
TP15
TP14
TP13
TP12
R719
R714
Q706
R715
Q705
R717
R713
CR700
R716
R721
R709
Q703
R710
R712
R711
Q704
R420
Q409
R417
C405
R418
Q410
Q408
R419
R414
R408
R416
R415
R409
Q407
Q406
Q405
R407
L400
C403
R413
Q404
R405
C400
C401
R410
C402
R411
R412
CR500
R505
R506
CR501
R513
R512
C404
R403
P507
R502
R503
R510
R504
R511
R405
R724
Q708
R722
C706
C701
R726
C700
L700
R702
R700
C702
Q700
Q702
R708
Q701
R707
R706
C704
R705
R703
L1
R704
Q400
R402
Q401
R401
R400
Q403
R404
C500
Q402
R500
C501
R509
R501
R508
N
K
M
4
10
11
8
5

FIG A-1 SHT 3

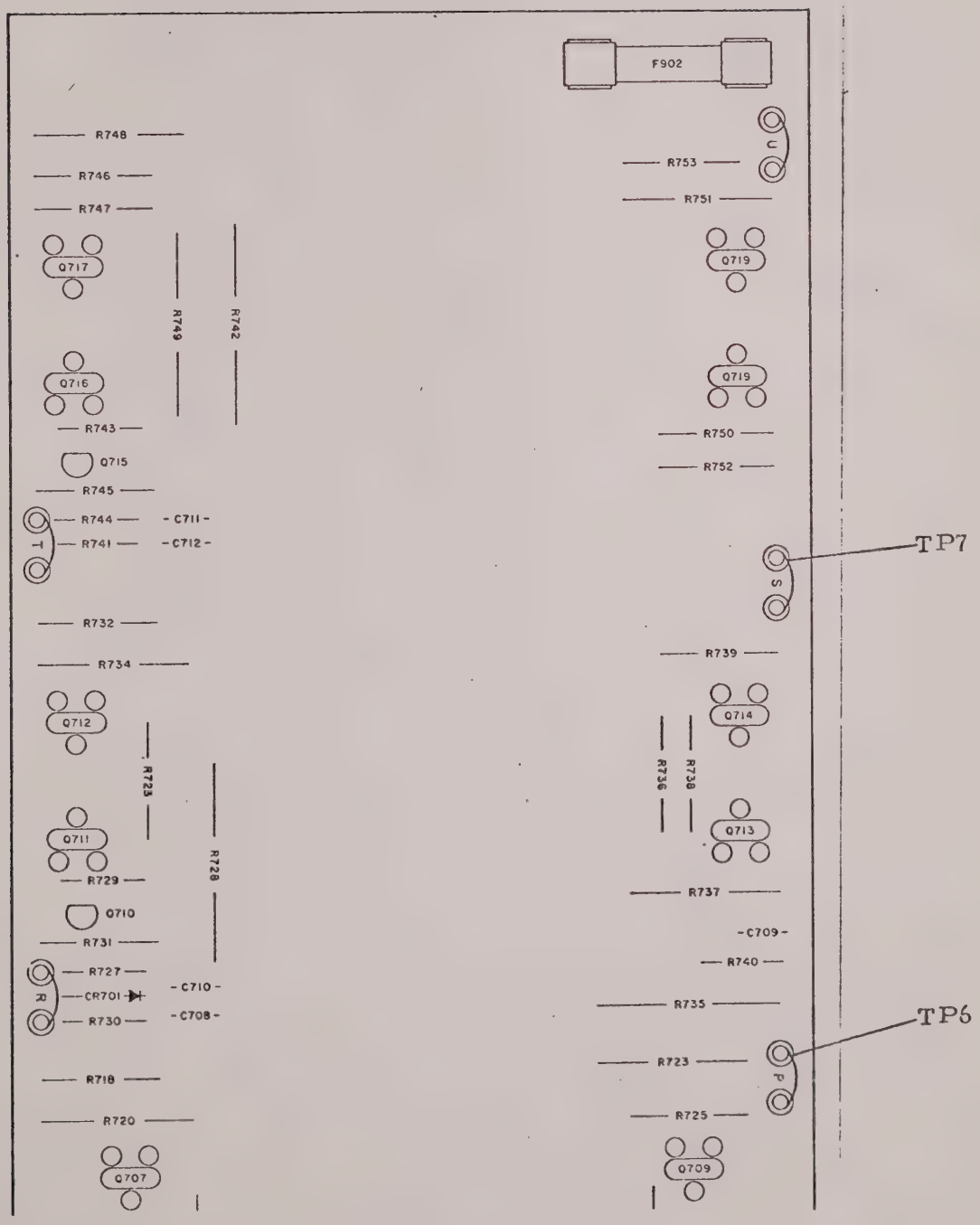

F902
R748
R746
R747
Q717
R749
R742
Q716
R743
Q715
R745
R744
R741
C711
C712
T
R732
R734
Q712
R723
Q711
R729
R728
Q710
R731
R727
CR701
R730
C710
C708
R
R718
R720
Q707
U
R753
R751
Q719
Q719
R750
R752
TP7
S
R739
Q714
R736
R738
Q713
R737
C709
R740
R735
TP6
R723
P
R725
Q709

FIG A-1 SHT 4

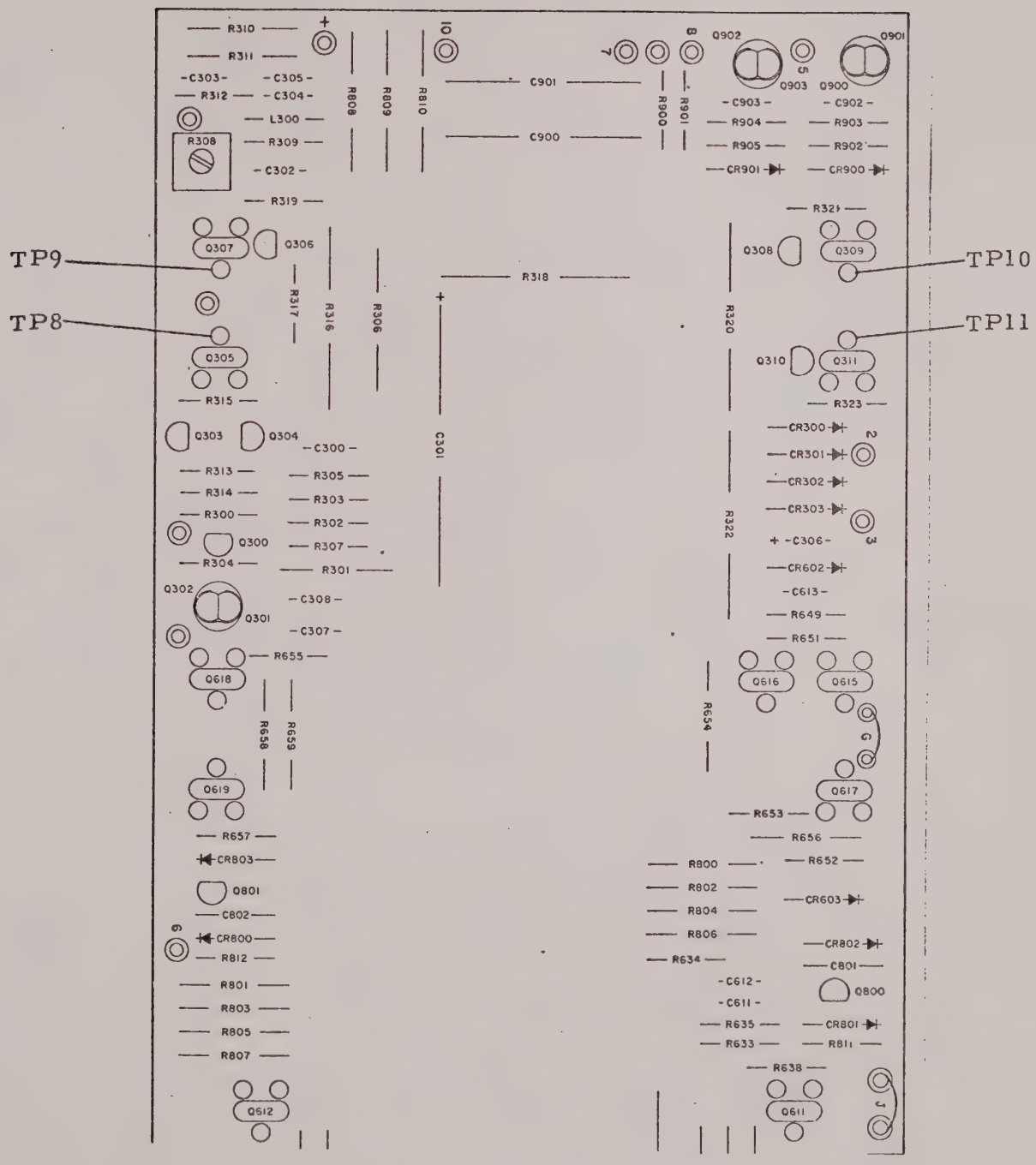

TP9
TP8
TP10
TP11
R310
R311
C303
C305
R312
C304
L300
R308
R309
C302
R319
Q307
Q306
R317
R316
R306
Q305
R315
Q303
Q304
C300
R313
R305
R314
R303
R300
R302
Q300
R307
R304
R301
Q302
Q301
C308
C307
R655
Q618
R658
R659
Q619
R657
CR803
Q801
C802
CR800
R812
R801
R803
R805
R807
Q612
R808
R809
R810
C901
C900
R900
R901
Q902
Q903
Q900
Q901
C903
C902
R904
R903
R905
R902
CR901
CR900
R321
Q308
Q309
R318
C301
R320
Q310
Q311
R323
CR300
CR301
CR302
CR303
C306
CR602
C613
R649
R651
Q616
Q615
R654
Q617
R653
R656
R652
CR603
R800
R802
R804
R806
R634
CR802
C801
Q800
C612
C611
R635
CR801
R633
R811
R638
Q611
10
7
8
5
2
3
G
9
J

FIG A-1 SHT 5

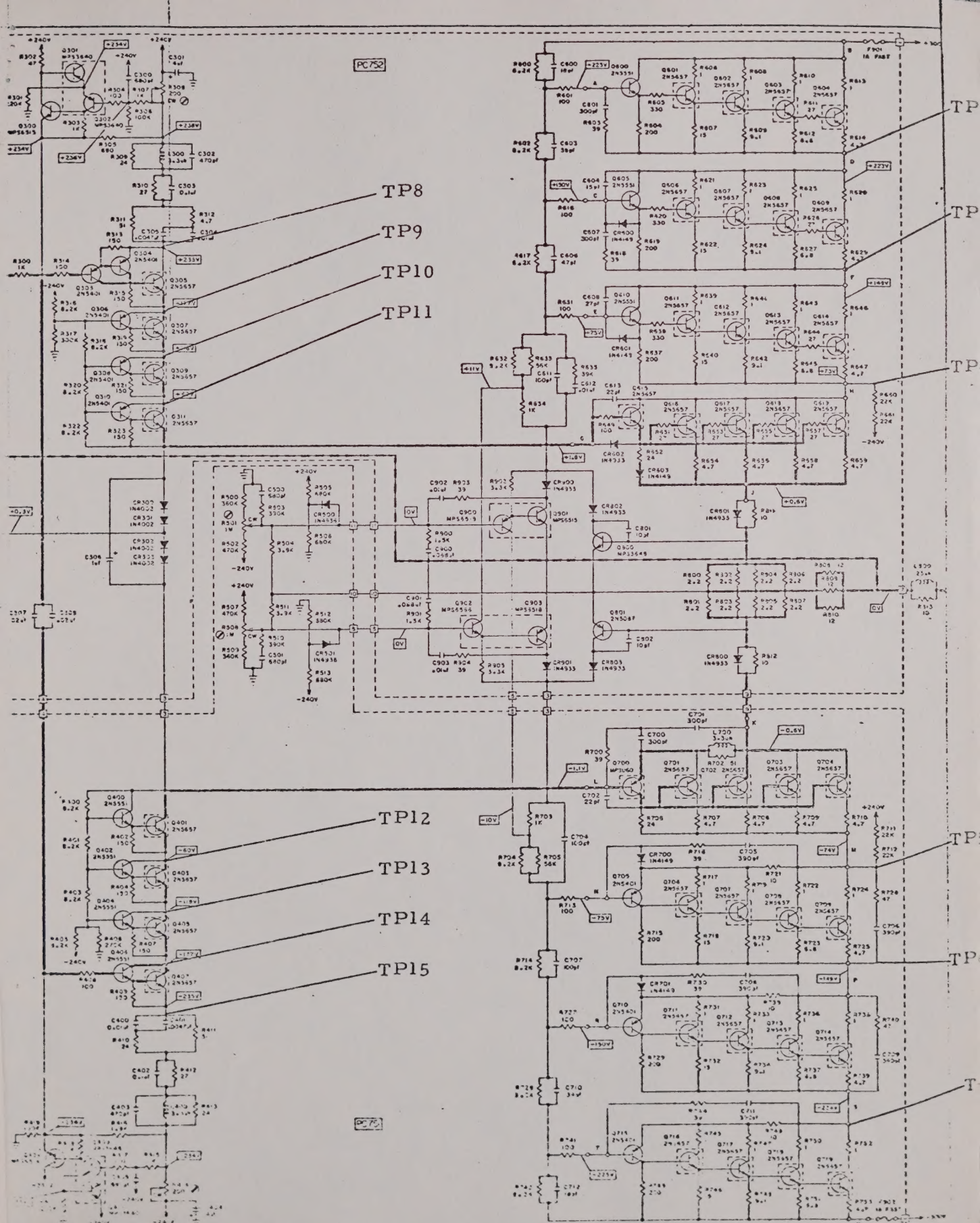


FIG A-2

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MP MASTER
MA22577